Popular Science

FOUNDED MONTHLY 1872

$1,000 IN CASH PRIZES THIS MONTH

AUGUST

See Page 12

25 CENTS

bring your radio set up to date

for greater distance for bigger volume- for finer tone

RADIOTRON
UX-200-A—
special detector tube for storage battery sets.

NEW RADIOTRONS- new performance—better radio! By keeping up with the progress of the Radiotron laboratories, you can get new results with your old set—keep it up to date. If you have a storage battery set, here is the way to equip it now, to make it *many times better:*

1. Distance! Take out the detector tube and put the new RCA Radiotron UX-200-A in the socket. This newest development of RCA research means greater sensitivity—longer distance reach.

2. Quality! Put all genuine RCA Radiotrons UX-201-A in the radio frequency sockets, and the first audio stage.

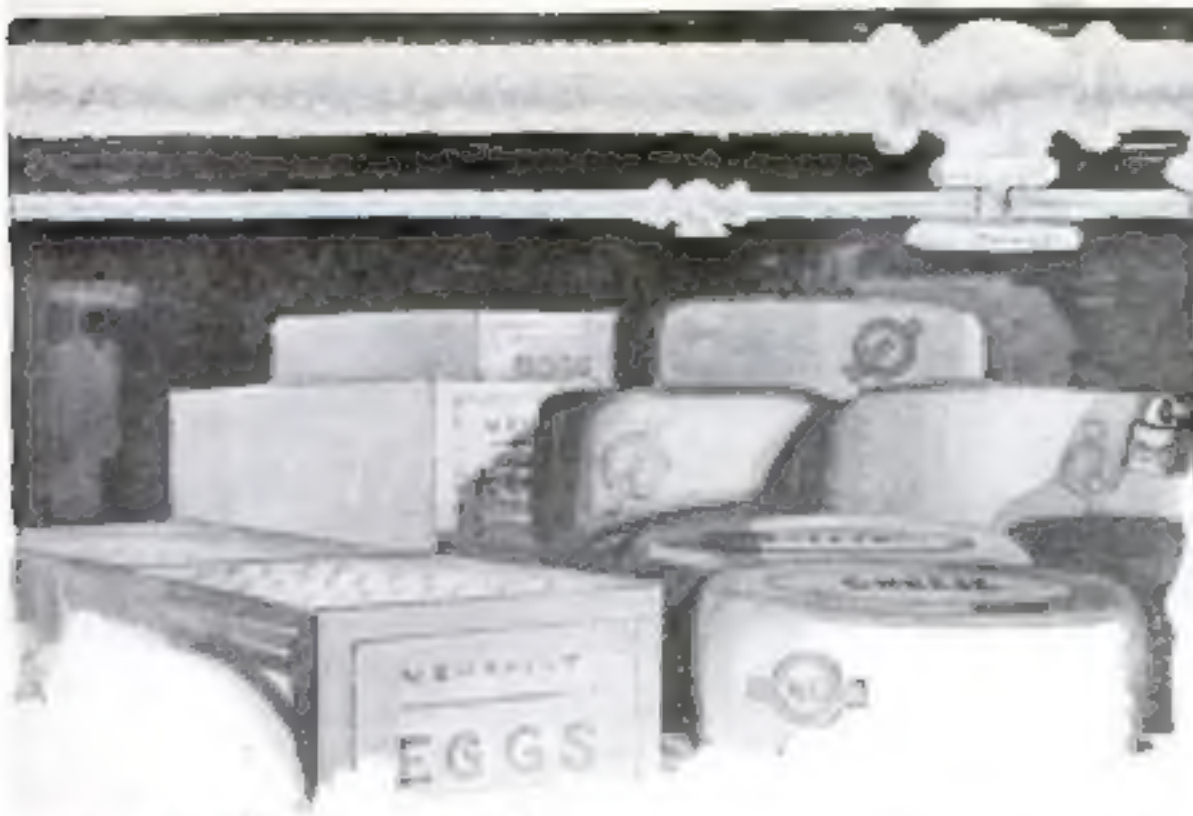
3. Volume, and finer tone! Use either power tube, Radiotron UX-112 or Radiotron UX-171 in the last audio stage, for volume—full, clear-toned volume.

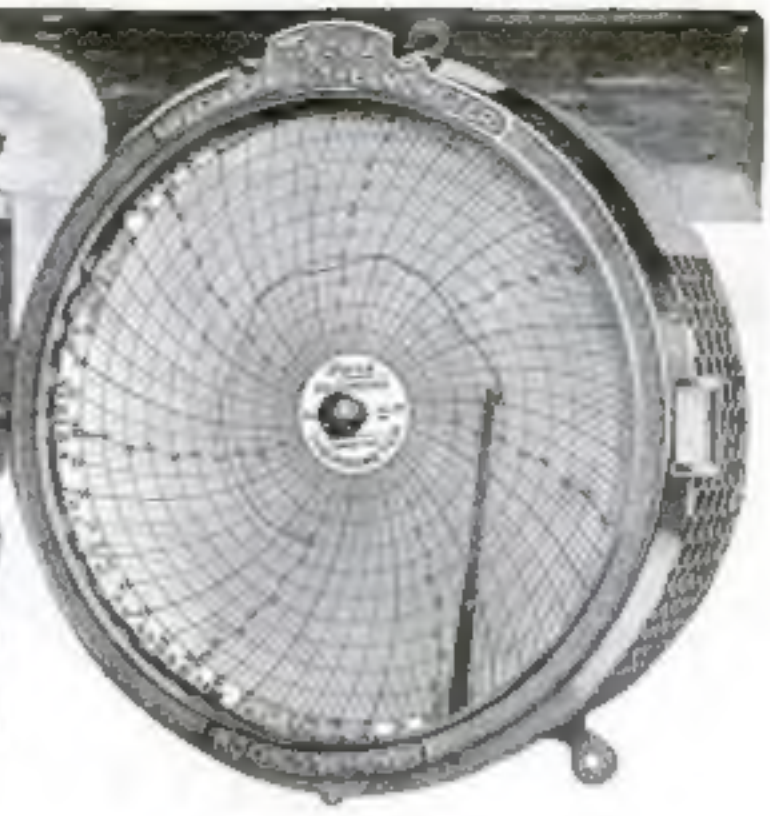
With the laboratories of RCA, General Electric and Westinghouse steadily at work to develop Radiotrons, radio reception is being improved year by year. Many of these improvements can be made right in your old set. Keep pace with Radiotrons. And, for your own protection, always look for the RCA mark on the base and inside the glass of every tube you buy.

RADIO CORPORATION OF AMERICA
New York Chicago San Francisco

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA





A Tycos Instrument

saves its cost each month in one of

CHICAGO'S LARGEST COLD STORAGE PLANTS

BY E. L. GIBBONS, *Chief Engineer*
Central Cold Storage Co., Chicago, Ill.

"OUR cold storage warehouse is one of the largest in Chicago, having 7,000,000 cu. ft. of cooled space. As in all plants of this type the ammonia gas on the compression side of the ammonia compressor must be kept at a certain temperature to give the greatest efficiency. Formerly the engineer controlled the temperature by feeling of the pipes with his hand, and adjusting the expansion valve to the point that seemed 'about right.'

"Three years ago we installed a Taylor Instrument Companies Recording Thermometer to replace this crude and unsatisfactory method. As a test we covered up the dial, forcing the men to operate as before, simply by their sense of feeling. The record showed that this old method was even more inaccurate than we had suspected, as the temperature fluctuated as much as 40 degrees both above and below the efficiency point.

"By watching the dial on the *Tycos* instrument the engineer can now keep the temperature variations down to 2 or 3 degrees. Formerly the man on watch could have neglected his job without being caught. Now the dial would show any neglect during the 24 hours.

"When the temperature is allowed to vary as it formerly did, a great deal more water is required for condensing the gas. We do not keep an exact record of the amount used but 20% saving would be a very conservative estimate of the proportion saved by installing a recording thermometer. At this rate, the *Tycos* instrument saves its cost each month."

TO MANUFACTURERS

If your manufacturing problems require the indicating, recording or controlling of temperature, there is a type and style of instrument in the Tycos Line of 8000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request, or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. • • U. S. A.
Canadian Plant: *Tycos* BUILDING, TORONTO
SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain

Tycos — for the Home

Your Office Thermometers
An aid in promoting human efficiency.

Your Bath Thermometers
To enable you to get the most good from your bath.

Your Wall Thermometers
To help you to maintain a temperature in your house conducive to good health.

Your Quality Compasses
To show you the right way in unfamiliar country.

Your Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Your Fever Thermometers
A necessity in every home.

Your Stormoguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above

Tycos — for the Medical Profession

Your Sphygmomanometer, Pocket & Office types
Your Fever Thermometers, Urinalysis Glassware
Bulletins on Request

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

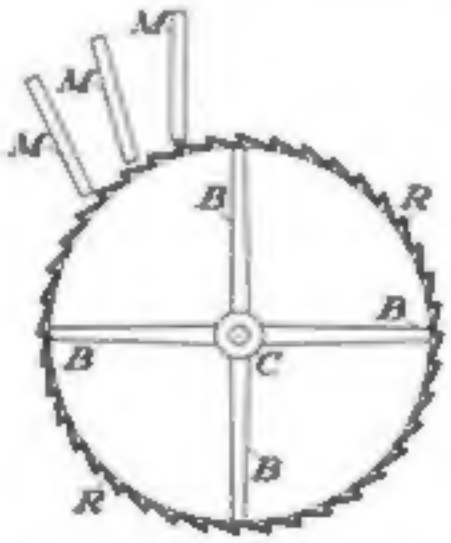
ALMOST A GENIUS

AN EDITORIAL

MOST of us get old too soon after we are born. We resist new facts because new facts involve mental effort. Resentment of new ideas is a real test for old age. A letter from Mr. W. D. Harry, of Canon City, Colo., illustrates what I mean.

"I recently have come across several copies of the *American Mechanics Magazine*, published in the year 1825 by C. S. Williams of New York," writes Mr. Harry. "At that time electricity was still considered just a curious thing in nature. Its use as power was unthought of. Yet the search for perpetual motion was still in the minds of many. I quote from a communication to the magazine:

"'Sir: I anticipate from you at least a laugh, upon receiving a communication on this subject; but if your risible faculties can be controlled, I would then invite a few serious comments. You will agree with me that the universe is an example of perpetual motion and that such a thing, beyond a doubt, does exist.'"



HERE, according to Mr. Harry, follows a goodly amount of text expressing the general philosophy of the writer and a description of a perpetual motion machine he has built. A design of this machine is reproduced for the readers of POPULAR SCIENCE MONTHLY on this page. The writer described his machine in these words:

"The above drawing represents a wheel of one foot in diameter, revolving on its center C. Its circumference RR is a thin steel hoop, or rim, three quarters of an inch broad, indented as indicated and connected to the center by two bars BB. (The thin edge presents itself to view.)

"MMM are three magnets fixed, totally unconnected with the wheel, spaced as close to the wheel as possible not to impede its going round. These three magnets are so disposed as to alternately exert their full attractive power at right angles, on the flat indentures of the steel rim of the wheel and as it moves around, the attraction of one does not cease its operation until another magnet exerts its full power.

"THE weight of the wheel on the side next to the magnet being thus continually lifted, or made lighter, by the attraction of the magnets, causes the wheel to preponderate on its center, the wheel to revolve and continue a perpetual rotary motion—at least as long as the magnets retain their attractive power."

"Think of it," says Mr. Harry. "Here was a man who actually was on the way to inventing an electric motor 101 years ago and didn't know it! He thought along the beaten track, and in consequence probably missed an opportunity to join the immortals."

That letter has a meaning for lots of us. It illustrates what Thomas Huxley, who, by the way, was one of POPULAR SCIENCE MONTHLY's first contributors, had in mind when he said, "Those who refuse to go beyond fact rarely get so far as fact."

Unfortunately most of us like best the things we already know. A closed mind is man's greatest handicap, receptivity to new ideas his greatest asset.—S. N. B.

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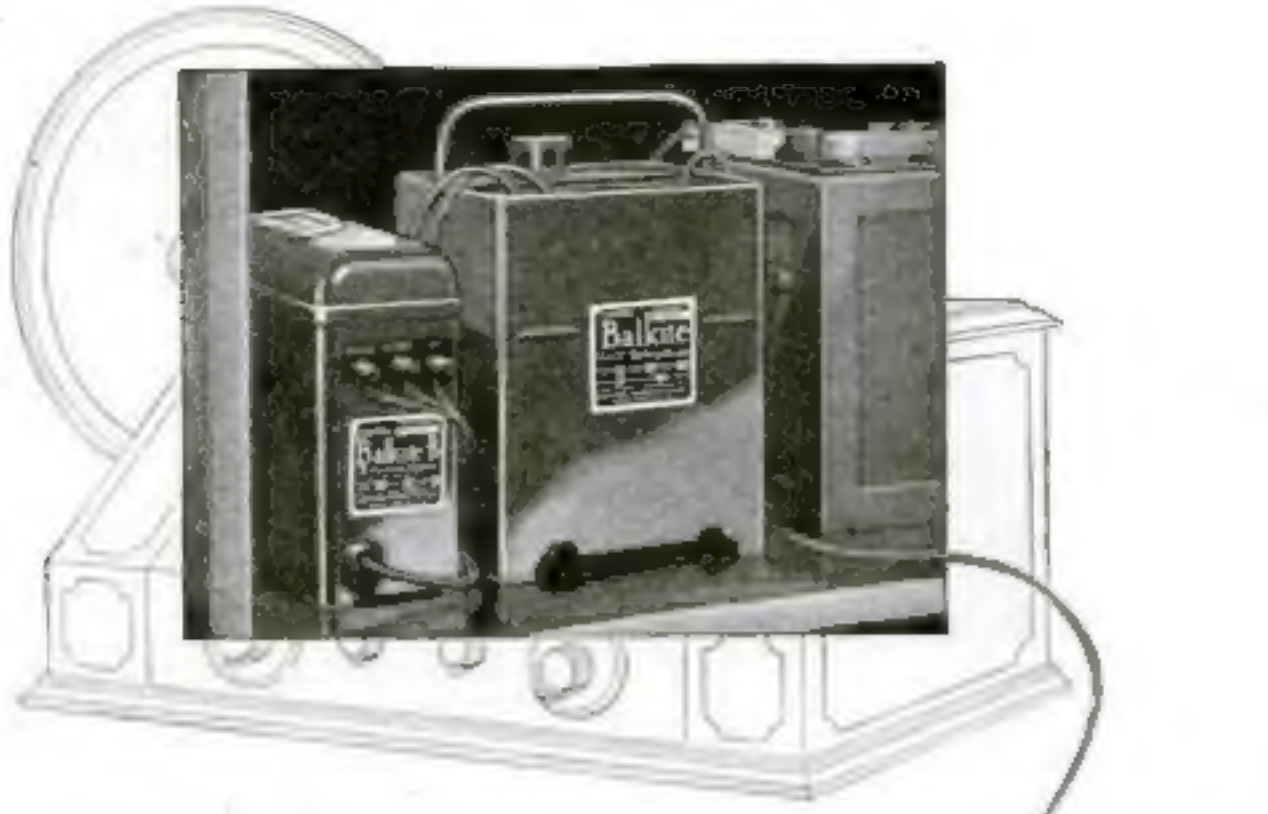


Your light socket is your radio power supply

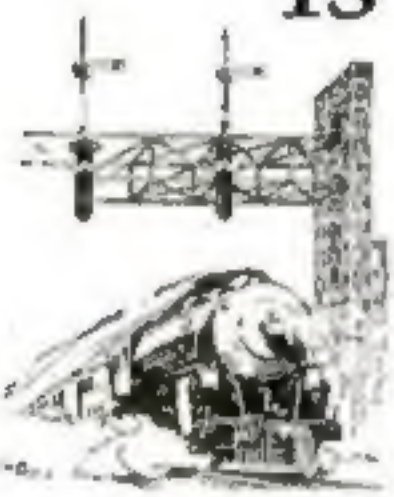
with Balkite "B" and the Balkite Battery Charger

Your most reliable and convenient source of power is your electric light socket. Balkite "B" and the Balkite Battery Charger enable you to use this power to operate your radio set.

Balkite "B" replaces "B" batteries entirely and supplies "B" current from the lighting circuit. It is unlike any other "B" device. It requires no replacements. It will outlive 20 sets of "B" batteries. With over 75,000 in use, on all types of sets, to our knowledge not one has ever worn out. It is tested and listed as standard by the Underwriters' Laboratories, and guaranteed to give satisfaction.

Entirely noiseless and usable while your set is in operation, the Balkite Battery Charger is the popular charger for radio "A" batteries. Its high charging rate makes it ideal for even the largest sets.

Add these two permanent noiseless Balkite Radio Power units to your receiver. Then you need never worry again about radio power. And with full power your set will give you a quality of reception to be secured in no other way. Ask your dealer.



The Balkite *Railway Signal Rectifier —Standard on over 60 Railroads*

In railway signal operation, where absolute infallibility is required, the Balkite Railway Signal Rectifier is standard on the signal systems of over 60 leading North American Railroads.

The method of charging used in railway signalling is practically the same as that used by the Balkite Trickle Charger with radio "A" batteries. At each signal is located a battery and a Balkite Rectifier which is connected to an AC current line. The rectifier is placed on permanent or trickle charge. It converts the AC current into direct current which is stored in the battery and operates the signal. The battery is always kept at full charge without attention.

This same method is also in use in many other industries. It is used for time recording, burglar alarm, fire alarm, emergency lighting, power plant control, substation control, instrument operation and telegraph and telephone battery systems.

In fact, there are no limitations for the use of this method. Wherever there is a battery and AC current, the Balkite Rectifier on trickle charge is ideal. It is noiseless, unfailing in operation, and has nothing to adjust, wear out or get out of order. Engineers, write for information.

FANSTEEL

Balkite ®

Radio Power Units

Manufactured by FANSTEEL PRODUCTS COMPANY, Inc., North Chicago, Ill.

Sole Licensees in the United Kingdom: Messrs. Radio Accessories Ltd., 9-13 Hythe Rd., Willesden, London, N. W. 10

Now You Can Be What You Want to Be!

And Let the "Money-Making Opportunities" on Pages 96 to 119 of This Magazine Point the Quick, Sure Way to the Career of Your Choice

"SQUARE pegs in round holes"—that's what so many men are today. Clerks and bookkeepers who should be electricians or builders . . . Farm workers who should be lawyers or salesmen . . . . Unskilled laborers who should be foremen or superintendents.

Are you doing the kind of work you want to do—the kind you enjoy doing? That, say wise educators, is the only way to win the fullest measure of success. Only as your career follows your natural inclinations and enthusiasms will you climb to the top.

Far too many leave their life-work to chance or accident. Far too many are "misfits," unsuited either by desire or by ability for the job they hold. That is why they fail to progress.

Plan your future along the lines of your "hobby," whether it's meeting folks, or inventing, or sketching pictures, or tinkering with cars or radios. Train yourself for a position of importance in work you *prefer* to do. Cultivate your natural bent, and turn it into a paying profession. Then promotions will come with an ease that will amaze you!

"WHEN one loves his work," said Ruskin, "his life is a happy one." Yes, we might add, and a *successful* one.

Today you can take the first step toward getting into the kind of work you want to do.

Turn to "Money-Making Opportunities," on pages 96 to 119 of this issue of POPULAR SCIENCE MONTHLY. Here you will find grouped, in one convenient section, a full directory of vocations: technical books, home-study courses and residence schools offering training in every conceivable trade and profession. In this fascinating array is the chance you are looking for.

$25.00

IN PRIZES

It will pay you to read "Money Making Opportunities"

[Pages 96 to 119]

Spend the next hour browsing through "Money-Making Opportunities." Study each advertisement with your future in mind. Consider each separate opportunity—picture yourself in that field—and it will be easy for you to decide which you like best and wish to make your career.

AND then—investigate! Write to that advertiser or advertisers whose proposition interests you most, for full particulars. Learn what other men have accomplished. Get the facts on what you can do, how quickly you can prepare for this work, and how rapid will be your advancement. The advertisers of "Money-Making Opportunities" will gladly send this information to you free of all obligation.

It used to be well-nigh impossible for the man without advanced education to succeed in a position calling for specialized knowledge and skill. But times have changed. Present day correspondence and trade school methods of instruction have been so perfected that any man can now learn the trade or profession he prefers, quickly, easily, economically. Regardless of your age, schooling or previous experience, you can secure in a short time just the training you need to make good in any field you may select.

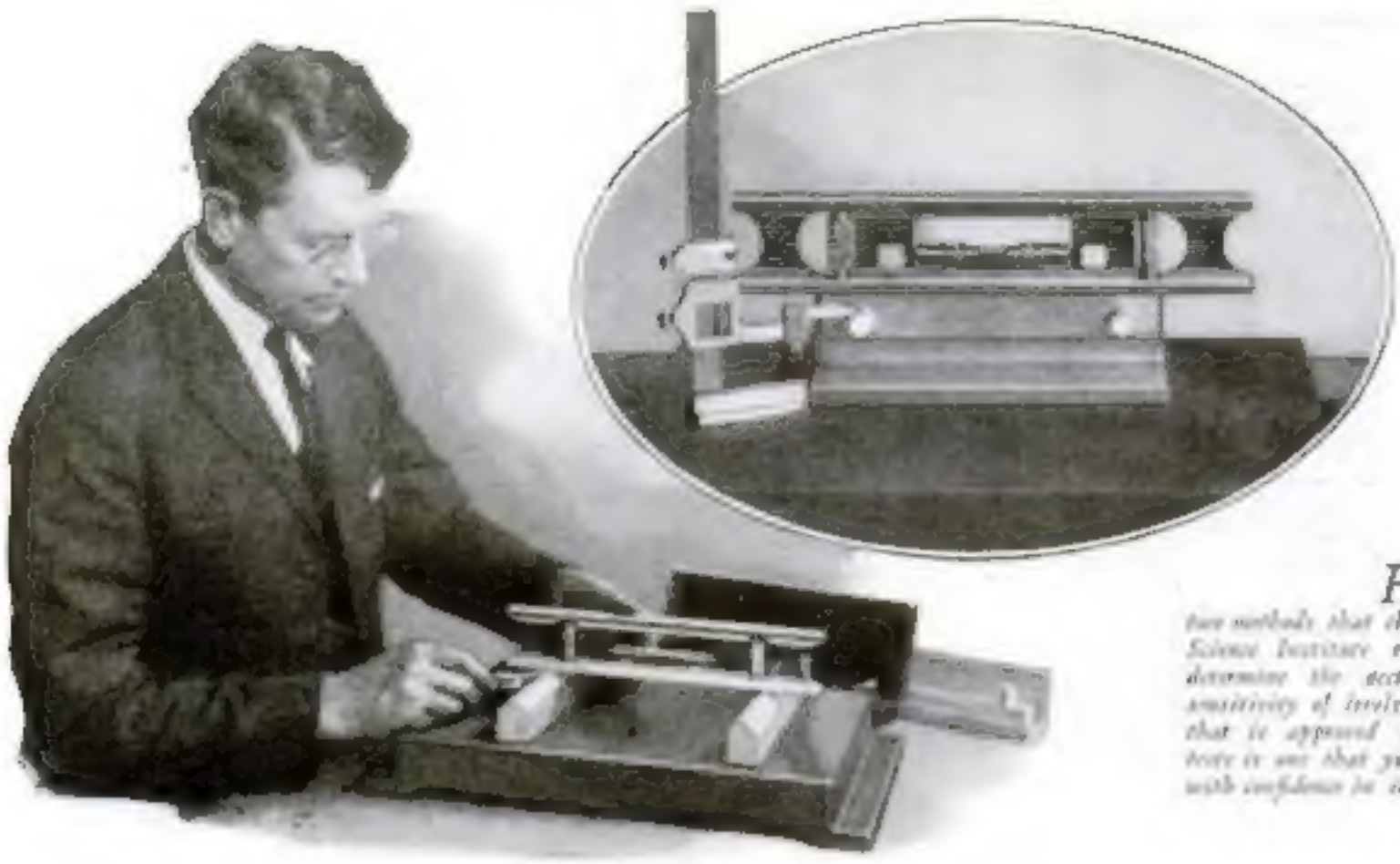
YOU run no risk in writing to advertisers in the "Money-Making Opportunities" section of POPULAR SCIENCE MONTHLY. Each is a reputable well-organized concern specializing in helping men to be what they want to be. Each can show long lists of names of clients who take pleasure in recommending these concerns to others.

Enlist their aid in your behalf—let them train you for work you will enjoy—and take your place in the ranks of successful men.

You need have no hesitancy about answering any advertisement of training, books, sales agency, or other opportunity, in the POPULAR SCIENCE MONTHLY. Every one is carefully investigated and only advertisers of reputable standing are permitted in this magazine. We do this to protect you. (*Continued on page 96*)

Money Making Opportunities
for Readers of Popular Science Monthly

Read the Advertisements Under the Above Heading! See pages 96 to 119 NOW!



HERE are two methods that the Popular Science Institute employs to determine the accuracy and sensitivity of levels. A level that is approved after such tests is one that you can buy with confidence in its accuracy

Take Care in Choosing *Your* LEVEL

WHEN one considers what a fundamental tool the level is, how important its use, and how much all construction work depends on leveling and plumbing operations, it seems remarkable that so little thought is given to the selection of this member of the tool kit.

Watch a man in a hardware store buying a level. He may even be a carpenter or mechanic, but the chances are ten to one that he will make his selection because the design or the finish of a particular level appeals to him. Possibly he may make a rough test by reversing the level, but that will be all. And a week later, if he has been ill advised, you can very likely see the same man back again buying a more accurate level. He may not know much more about buying the second level than the first, but he will have a far greater conception of how important accuracy is in a level and that will be the quality he will insist on before making a second investment.

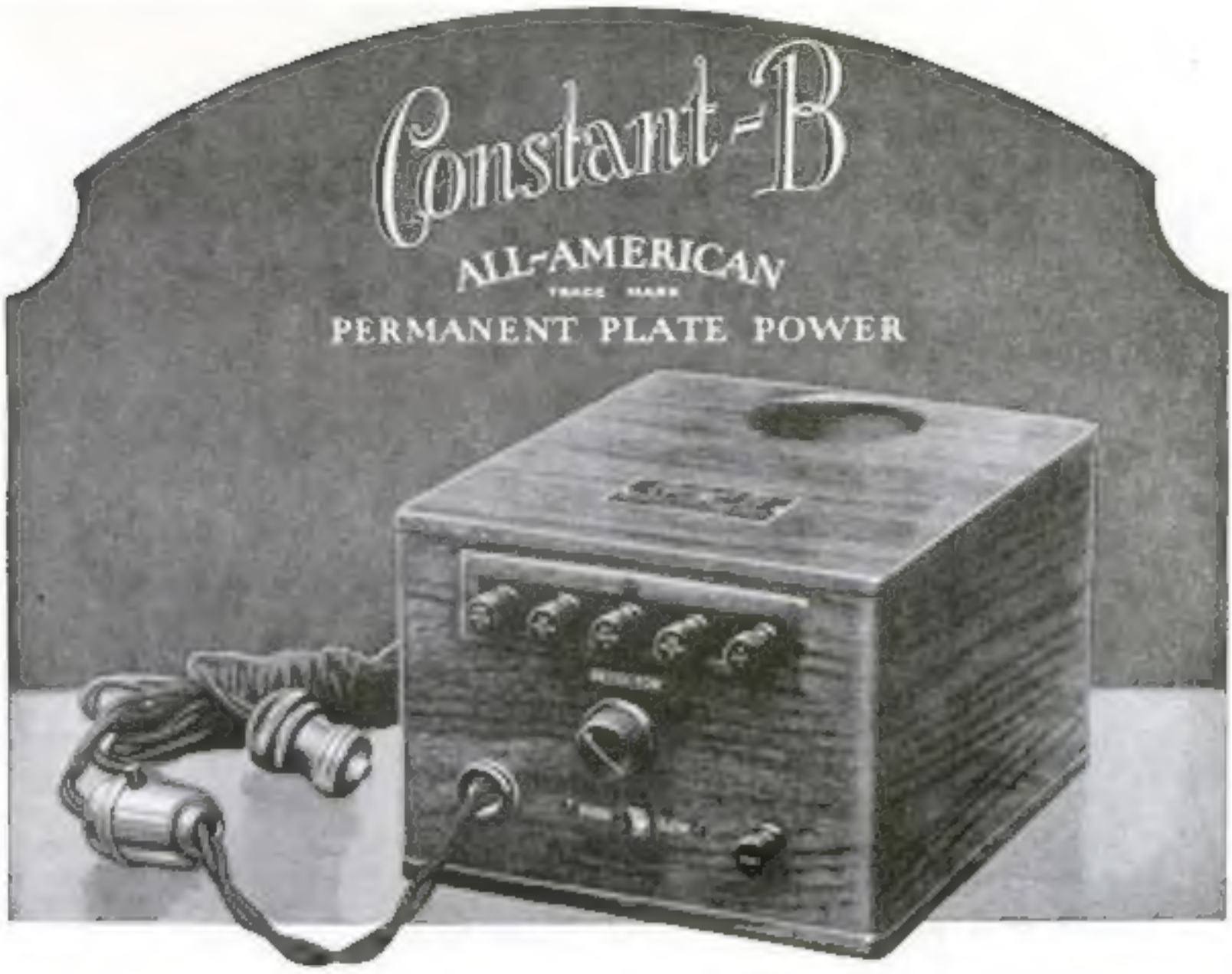
It is hard to tell, just from the looks of a level, how it is going to perform. In the case of many other tools, the external appearance gives more or less of an inkling of their quality, and also their defects show up immediately in use. In the case of a level, however, the inaccuracy is discovered too late. If you use a cutting tool that is not up to the mark, you know it before you are too far advanced with your work, and there is time to make a change. But it is a pretty serious proposition when you find that a whole structure is off level, just because the instrument used was not accurate—it is too late then to rectify the trouble and it means that the expense involved is going to be all out of comparison with the original cost of the most expensive level.

This is the chief reason why you should not try to economize on this particular article of tool equipment. It is true economy to buy a good level made by a concern with a reputation for quality tools. Another factor that makes a careful choice and fairly large initial expense advisable in buying a level is that such an instrument, with reasonably good care, will last a lifetime. Right here it might be well to mention that a level should never be dropped, and it should be given the careful treatment that is accorded to all sensitive precision instruments.

The kind of level you decide on is dependent, of course, on the type of work for which it will be used. But whether you are a mechanic, carpenter, or home workshop tinkerer, there is one essential rule that the Popular Science Institute of Standards would advise you to follow in purchasing a level. Select one that will serve for the *most accurate work you ever do*, rather than for the general type of work for which it will be used. It invariably pays to do this, for there is probably no other tool that can wreak quite as much havoc as an inaccurate level.

SOME very rigid and exacting tests have been devised for measuring the accuracy of levels by Professor D. S. Trowbridge, who is in charge of the level tests made by the Popular Science Institute. Professor Trowbridge is Head of the Department of Surveying at New York University and is recognized as an authority on the subject of levels. The tests are highly technical and determine authentically what levels have the accuracy necessary for good work.

In buying a level, or any other tool, the Institute recommends the selection of those that have passed its tests, or that you at least be certain that they are of a reliable advertised brand. A list of approved radio and tool equipment can be secured from the Popular Science Institute of Standards, 250 Fourth Avenue, New York City.



Steady "B" power without batteries

Pure full tone is possible only with "B" voltage kept constantly *up to standard;* All-American "Constant-B" *gives it to you*

YOU'VE had your "B" battery troubles; everybody has. Here's a permanent end to them—install an All-American "Constant-B," attach it to a light socket, and turn on the switch. You get a dependable, permanent supply of uniform, constant plate current; insuring full, pure tone.

There's no acid to ruin things; no annoying hum. And all inside units are permanently sealed against atmospheric conditions.

"Constant-B" has taps for 135, 90 and 67½ volts; and a 10 to 60 volt tap varied in output by a "Detector" control. The "High-low" switch insures uniform voltage, regardless of the number of tubes used; "Low" for 2 to 5 tube sets, "High" for sets with 6 tubes or more.

"Constant-B," after passing the highest laboratory tests, carries the seal of approval of the Popular Science Institute of Standards and other testing laboratories. It measures up in every way to All-American's high standards of painstaking workmanship and satisfying performance.

PRICE
$37.50
Complete with Raytheon Tube

Descriptive folder and interesting booklet showing how to build a "B" Power Supply similar to "Constant-B" unit free on request. Specify bulletin B-82.

ALL-AMERICAN RADIO CORPORATION
4205 BELMONT AVE., CHICAGO, U. S. A.

Station WENR—266 Meters—is owned and operated by the All-American Radio Corporation

Tune them out and KEEP *them out with* Filtrola STATION ELIMINATOR

This attractive compact unit, complete in itself, makes it a simple matter to tune out interfering stations you don't want—even the most powerful. No tubes, batteries or other extra to install. A typical All-American product in its precision and quality of workmanship.

Price $15

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Which Quality Do *You* Desire Most?

A B

The high-wave reception range of the Grebe dial (B)—from 550 down to 240 meters—equals the practical tuning range of the usual receiver. The low-wave range of the Grebe dial (A) provides additional reception down to 150 meters.

Grebe Binocular Coils
Reg. U. S. Pat. Off.
and
Low-Wave
Extension Circuits

Grebe
S-L-F Condenser
Reg. U. S. Pat. Off.

Grebe
Colortone
Reg. U. S. Pat. Off.

"If you have fields and will not plow them, your barns will be empty."

If you want the best in radio and fail to buy the Synchrophase, you must blame only yourself.

Dudley Hyn

All Grebe apparatus is covered by patents granted and pending.

MANY radio enthusiasts consider tone quality the most important characteristic of a radio set, with selectivity a close second; others reverse the order. But practically all agree that every set should be judged by the amount of tone quality and selectivity which it exhibits.

The Synchrophase possesses both these qualities in a remarkable degree, because of two exclusive Grebe developments—The *Colortone* and *Binocular Coils*.

The *Colortone* gives full control over the loud speaker, harmonizing it with the set and keeping the pitch right for voice or instrument. It also makes it possible to reduce, to a great degree, disturbances due to static and to suppress high-pitch frequencies caused by heterodyne interference of one station with another.

The *Grebe Binocular Coils* keep the set free from disturbing waves from undesired stations, giving an isolation that is unusual.

Ask your dealer to demonstrate all exclusive Grebe developments which make reception so remarkable

A. H. Grebe & Co., Inc., 109 West 57th Street, New York
Factory: Richmond Hill, N. Y.
Western Branch: 443 So. San Pedro Street, Los Angeles, Cal.

This company owns and operates stations WAHG *and* WBOQ.

The GREBE SYNCHROPHASE

TRADE MARK REG. U.S. PAT. OFF.

The Synchrophase is also supplied with battery base

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 4.

POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
August, 1926

A Doctor Discusses Sex Appeal

Why all gentlemen don't prefer blondes and why two people with red hair rarely marry—Why we love the women we do, explained in an unusual way

By Frederic Damrau, M.D.

"WHY, whatever can he see in that girl?"

You've heard the question often. Quite likely you've asked it yourself. You've heard women ask it indignantly—women with personal designs on the young man under discussion. Or, perhaps, if the victim happened to be married when you have put the query rather compassionately, having in mind your friend's remembered stipulations of more youthful days.

And now look at the girl he's picked! Beautiful? Possessed not? Hardly to be called attractive. Yet, you recall vaguely, Harry always said he preferred the plump ones.

"I like to know I've got someone in my arms," he used to say.

Still the question refuses to be downed:

"Whatever can he see in that girl?"

The answer is he just couldn't help himself. He had to fall in love with that particular woman. And if you're still single the same kind of fate is in store for you. That is, you will find yourself irresistibly attracted to a certain girl for reasons of which you even consider them, what is doubtful, quite unfashionable.

The solution of the riddle goes back to your cradle days. Before you could talk or walk almost before the time you could distinguish objects clearly you began forming your impression of the ideal girl.

And the basis of that ideal, the real root of sex appeal, is your mother.

A hand reaches into the crib to tuck you in. The same hand guides food to your mouth, you associate a certain form with your comfort and well-being. Gradually the purely animal satisfaction resulting from gratification of physical needs ripens into affection. Your ideal takes the shape of the one who has made the greatest sacrifices uncomplainingly for your sake.

Girls have similar experiences. A girl discovers her heart palpitating when in the company of a man whose voice is of a certain pitch, whose laugh is hearty, whose shoulders are broad. She realizes it would not be difficult for her to fall in love with him. And she will find no doubt about it—that the man who was nearest her in her baby days—the one who bounced her on his knee and pushed her buggy through the park—had that same vocal pitch or hearty laugh.

This is no theory of mine. It's the finding of the new psychology. And I've confirmed it to my own satisfaction with independent tests.

Of late, questionnaires have been exceedingly popular, and the college lads have borne the brunt of the interrogating. Which is more popular, corned beef or chicken à la king? Ask the college boys. Is Gloria Swanson or Mary Pickford the better actress? Ask the college boys. Are flapping galoshes responsible for the flapper, and if so, why? Ask the college boys. Throughout the deluge the lads have been serenading uncomplainingly, revealing their innermost thoughts. Much information of real value and much not, too, are the result of all this.

Possibly you recall a recent survey in which the youths were asked to describe their ideals of womanhood. When they planned to settle down to matrimony, which would they choose for life partners—the flappers or the old-fashioned girls? And you will remember that, despite the students' apparent fondness for the 1926 model as a roadster companion, he voted to cast her out when it came time to switch to the matrimonial flivver.

WHY? The answer is simple. The lads at college today came into the world a few years after the birth of the twentieth century. Most of their mothers were of the old-fashioned type who looked askance at flappers. And since a mental picture of his mother as a flapper shocked him, he could not complacently visualize his future wife in the same pose.

Not only that but the young men were on record overwhelmingly as opposed to their wives working. The subconscious reaction was that their mothers didn't and their mothers, remember, are their ideals.

Another interesting sidelight on the question was thrown by a survey made by the Bureau of Social Hygiene, under the direction of Dr. Katherine B. Davis. Questionnaires, bearing queries of the most intimate nature, were sent to 1,000 women. They dealt with the relationship between man and wife, with the ultimate object of determining what conditions tended to make married life

Women Men Marry

IF YOU ever wondered what an old friend saw to admire in the plain girl he married, this article is sure to interest you. Maybe it was the tilt of her head, or a seductive scent, or the way she wore her hair. But whatever else it was, there was one underlying reason, the same impulse which, Dr. Damrau says, all men subconsciously follow. The writer is a leading neurologist of New York City, and his conclusions are based on observations of hundreds of cases. Read his article and ask yourself if he isn't right.

happy. And the women who continued to work after they were married far exceeded the "home bodies" in the unhappy group!

Bear in mind, I am not trying to argue against married women in business. I merely cite this as I think it strengthens the theory of sex appeal as I am outlining it. Married women of a generation ago did not go out to work, it simply wasn't done; and, although their sons, believing themselves broadminded on the subject, agreed to permit their wives to continue working, it irritated against the peace of the household. What psychology calls the "mother complex" was stronger than reason.

NOT so many years ago Professor Sigmund Freud of Vienna, set the medical world agog with his startling theories regarding the queer doings of the human subconscious mind. The great point in Freud's argument was the sex life of children. An important point he made was that, as a rule, the baby's first love is his mother. As he grows older, this mother romance is likely to become a complex, meaning a group of ideas bossed by a constant craving. The craving is for his mother's love; the group of ideas, everything connected with his mother.

In later life, the average man takes the mother complex as the standard of perfection, and it's the little things that count. A man may fall in love because of the tilt of a woman's head; a seductive scent that stirs him unaccountably; the way she wears her hair. But the mother complex is back of it all.

Gloria Swanson owes her present eminent position in the film world to the manner in which she leaned against a door. Sounds ridiculous, doesn't it? Yet the story is vouched for by the man who had the most to do with starting her on her meteoric career, Cecil B. de Mille, the famous producer and director.

During the filming of one of the early Mack Sennett comedies, Mr. de Mille's attention strayed for a moment from the principals to the slim figure of an extra whose presence meant little or nothing to the success of the picture. Something in the attitude of the young woman as she stood against a door caught the director's eye and held him spellbound.

"SHE leaned like a woman in distress," he said later, "with her soul expressed in the pose of her body."

For the remainder of the day Mr. de Mille watched the girl anxiously, and was disappointed. "She was very, very bad for the rest of the time," he admitted, "but on the strength of those few seconds he gave her a chance at something better. Now see where she is!"

So it is with love. Just such a pose, provided it duplicates an attitude struck by a man's mother, may mean he will start wooing her ardently, his mind made up before he has even seen her face.

"But," you may object, "this feature of resemblance does not work out in my case. My mother was a brunette—deep brown eyes, black hair. And I'm married to the sweetest girl in the world, but she is a blonde, not the drug store variety, either. Everyone knows how dissimilar these types are."

But are they? Who says so? I hate to shatter a belief of such long standing, but I must in the interest of truth. Except for pigmentation, the blonde and the brunette are virtually interchangeable.

You don't have to take my word for that. I'll refer you to a test made recently at the University of Minnesota—another one of those questionnaires—by two

Five Men Married Her

Is it because she is blonde? Is it because she is beautiful? Just what is the appeal that our own much married Peggy Joyce exercises on the male of the species? Dr. Damrau would say it is not because she is all things, but because she is one thing—the mother memory to all men. Is the doctor right or is he wrong?

members of the faculty. They had their doubts that the brunette invariably is positive, driving, hopeful, and loving, while the blonde is negative, pleading, submissive, and static.

A list was prepared of various traits attributed to both types and given to ninety-four students of psychology. Each was told to select two pronounced blondes and two equally decided brunettes from among his acquaintances, and to judge them with respect to the characteristics on the list. The students were not informed of the purpose of the test, that they might not unconsciously follow the old formula.

It was discovered that no possible line of demarcation could be drawn. Whereas one student ascribed positiveness to a blonde of his acquaintance, another credited his brunette friend with the same trait. And so it went all the way down the line. Vigorous brunettes, passive blondes; passive brunettes and vigorous blondes.

So, you see, color does not necessarily have anything to do with it. It is true that in most instances a blonde will marry one of that type and brunettes will mate in a majority of cases, but the reverse will not upset my original premise.

All the above does not completely explain the choice of the mythical Harry mentioned in the opening paragraphs. The point that sticks in the back of your head is that Harry in his youth insisted that his future wife be beautiful. "And," you remark with derision, "look at what he picked!"

In answer to this I'll say that Harry's wife is beautiful, and will then apparently contradict that statement by declaring there is no such thing as intrinsic beauty. In your talks with this misguided—as you believe—young man, you may have assumed that both of you had the same idea as to what constituted beauty. Actually, your views were widely divergent. Harry will be just as disappointed in your choice, probably, as you were in his, because beauty is in the eye of the beholder. That, of course, is no new theory, and sounds somewhat banal, yet it always seems to come as a surprise, and requires backing up.

WITH that in mind, I asked three young men of my acquaintance which of the following movie stars, Lillian Gish, Mae Murray or Nita Naldi, they considered the most beautiful. I purposely selected those actresses, representing as they do very distinct types. I got a vote for each one!

Less than a month ago one of a rapidly depleting bachelor group marched to the altar, but the woman who knelt at the rail with him was not the pretty little girl who had been the object of his sporadic attentions. Another took her place; one who, though frequently seen in our friend's company, was, we thought, never seriously considered as a candidate. As a matter of fact, most of us secretly envied his pre-matrimonial standing with the one who lost out. She was pretty—I mean by that she answered my conception of the word—and an agreeable companion. Furthermore, it was plain to be seen from her actions that she did not regard our friend as less than dirt.

Yet he fooled us all by marrying a girl whom I considered positively plain. I ran offhand way I asked him—when his wife was not around, of course—what had become of his flapper friend, and how was it that negotiations had been broken off?

"OH," he replied, "she was all right, but—"

He didn't finish the sentence, but I knew what he meant. She wasn't his dream girl, and the one he married was.

Possibly you are still unconvinced. Then make this test for yourself. Cut out the photographs of a dozen pretty women from a magazine or rotogravure section and submit them to as many men, with instructions that each select the one he considers the most attractive. You're bound to get a variety of answers. And you'll probably find yourself waxing indignant at some of the selections. Bear in mind, however, that your pick will be frowned upon, too.

Beauty contests have become one of our most popular (Continued on page 104)

Strange Warship Defies Attack

Italian Plans a Semisubmersible to Resist Bombs, Guns and Torpedoes

THIS strange semisubmersible battleship proposed by Nabor Soliani, Italian naval engineer, is shown subjected to gun, bomb and torpedo fire. When attacked, the ship can submerge until only the superstructure is visible, and that is encased in six-inch armor and filled with cork, forming a "raft" for the submerged ship. Even with the entire superstructure destroyed, the ship is not vitally injured. One third of her 20,000 tons' displacement is water ballast, filling the anti-torpedo bulges at the sides, so that, if torpedoed, the only result may be a drop in speed

$1000 in CASH PRIZES—

Winners in the March Contest Tell How They Found Mistakes of John and Mary How Many Can You Find?

WHEN the judges decided on the prize awards in the first of our great monthly series of $1000 Picture Contests, we wrote to the leading prize winners and asked

"Just how did you go about the task of finding the mistakes of John and Mary Newlywed, and of the artist who drew the picture in the March Contest?"

The replies showed such ingenuity in devising systems to "spot the mistakes, that we are passing the suggestions along, in the hope that they may aid you with this month's Contest picture which appears on the opposite page.

This is how Arthur Stert of Ferndale, Mich., (you'll see his picture on page fourteen with other winners) won the first prize of $500

"The best lesson I learned from studying the picture," he writes, "was the value of perseverance. The first fifty mistakes came easy. After that I spent a few minutes each day, firm in the resolution to find at least one additional error at each studying, writing down every one."

G. A. Graham of Baltimore Md. winner of the third prize of $50, employed a different but equally effective method

"After taking a preliminary survey of the picture I started at a given point and worked around from that point examining every object, surface and line with suspicion As mistakes were observed they were noted down

Another of the prize winners, J. G des Rivieres of Ottawa, Canada, found that by drawing an outline copy of the picture "many mistakes were revealed which otherwise would have remained undiscovered."

Still another winner B. L. Jirou of El Paso, Tex., compared each object shown in the Contest picture with a correct picture of a similar object, obtained in a reference book. In this manner he was able to "note each difference of general construction and detail."

Virtually every one of the winners, whose names appear below and thousands of other readers have written enthusiastically of the value of our contests in developing a large knowledge of the proper way of doing things in the search for the errors in the pictures and of their value in increasing powers of observation. It was in the hope that the contests would have these results that the series has been presented. And it is because it has had these results that, although this is the last of the series of competitions, we plan to continue the pictures as a regular monthly feature Our picture puzzles will offer you useful information in an interesting form a fascinating game for the whole family

Look, for a moment, at this month's Contest picture. At first you may see nothing unusual in it. It simply shows John Newlywed in his cellar, searching for trouble that has caused failure of his household electrical supply. His wife, Mary, is there, too, doing the washing.

BUT actually, John or Mary, or both, are doing one or more things in the wrong way. What are they doing wrong, and why is it wrong? What mistakes has the artist made in drawing the picture? How many mistakes of all kinds can you find? How observant are you?

First, read the rules carefully, then begin the search for mistakes You'll find the Contest not only extremely interesting but profitable as well.

Are You Alert?

POPULAR SCIENCE MONTHLY will award $1,000 in sixty-three cash prizes for the best answers submitted in this, the last, of this fascinating series of contests. Cash prizes will be distributed as follows:

First Prize	$ 500
Second Prize	100
Third Prize	50
10 Prizes, $10 each	100
50 Prizes, $5 each	250
Total Prizes	$1,000

Prize Winners in the Contest Published in Our March Issue

FIRST PRIZE, $500—Arthur Stert, Ferndale, Mich
SECOND PRIZE, $100 Floyd J Walter, Albany, N Y
THIRD PRIZE, $50—G. A. Graham, Baltimore, Md

$10 PRIZE WINNERS

K. L. Bridges, New York City
John Cline, Alix, Ark
J G. des Rivieres, Ottawa, Canada
C R. Helper, Sturgis, Mich
B. L. Jirou, El Paso, Texas
C. J and A. W Manuel, Perkasie, Pa
Howard Vincent O'Brien, Winnetka, Ill.
B. Rowe, New York City
Stanley Spannaus, Mayville, N. D.
Fred H. Tanke, Norwood, Minn.

$5 PRIZE WINNERS

Walter E. Adams, Omaha, Neb.
John Mott Avent, Staten Island, N Y
I F Bachelder, Waterbury, Conn.
David M Bauer, Norristown, Pa.
Roland Becker, Carbondale, Pa.
Andrew P Berendsen, Bay Point, Calif.
Paul L. Brandt, Altoona, Pa.
J. B. Brown, Jackson, Mich
Lowell M Brown, Bartlett, N H
G. W Carbee, Los Angeles, Calif.
Aaron Lee Carthage, New York City
Robert S. Danskin, Arlington Heights, Mass.
Thomas E Davies, Nemacolin, Pa.
Harry Hatton, Burnettsville, Ind.
Henry M. Holmes, Rochester, N Y
Alfred E Hubbard, Lansdowne, Pa.
Robert L. Horton, Hackensack, N J.
M. A. Lecrone, Karthaus, Pa.
Walter E Mayer, Youngstown, Ohio
T M. McEwen, Springfield, Mass.
Robert L. McFarland, Brooklyn, N Y.
Joseph E. McIlwain, Ralston, Pa.
Evelyn C. Mess, Indianapolis, Ind.
Gordon B. Mess, Indianapolis, Ind.
Clement E. Moyer, Penbrook, Pa.
George W Myers, Honolulu, T H.
Richard W Page, Grand Gorge, N Y.
William B. Parmelee, Chicago, Ill.
Rene D. Pepin, Springfield, Mass.
D. H. Petithory Pensacola, Fla.
Harold Trent Power, Piedmont, Calif
Alfred T Renfro, Bellevue, Wash.
J. W Riddle, Alice, N D
Eric B Roberts, Regina, Sask., Canada
P W Rushforth, Honolulu, T H
A. P. Rutherford, Salem, Ore.
Duard E. Scott, Wellington, Tex.
Ray H Seaman, Detroit, Mich.
Charles T Sharpe, Los Angeles, Calif
R. H. Sherry, Evanston, Ill.
T H Simmons, Boston, Mass
Lawrence Eugene Smith, Cleveland Heights, Ohio
Mr and Mrs. P J Steen, Two Dot, Mont.
Vernon Taylor, Oberon, N D
Hugh D. Vis, Portsmouth, Va.
George A. Webster, Glens Falls, N. Y
H. E. Wichmann, Stoughton, Wis.
J E. Willson, Jr., Charlotte, N. C.
N Lewis Yerkes, Hatboro, Pa
Martin W Zollner, Waukesha, Wis.

SEE PAGE 14 FOR PHOTOGRAPHS OF SOME OF THE WINNING CONTESTANTS

What's Wrong *in* This Picture?

Something has caused a failure of the electrical supply in the home of the Newlyweds, so John goes into the cellar to try to locate the trouble. Mary, meanwhile, gets an early start on the week's wash. What things are John, or Mary, or both, doing wrong, and why are they wrong? What mistakes has the artist made in drawing the picture? See how many errors of all kinds you can find. The rules of the contest are given below

The Rules of the Contest—Follow Them Carefully

1. John and Mary Newlywed appear above in another of the series of Contest Pictures which POPULAR SCIENCE MONTHLY has been printing from month to month. The picture shows John or Mary, or both, doing one or more things in the wrong way, and, in addition, there are a number of deliberate mistakes by the artist in drawing the picture. You are to tell us what things are being done wrong and what things are drawn wrong in each picture, and why they are wrong.

2. POPULAR SCIENCE MONTHLY will award $1,000 in 63 cash prizes for the best answers giving the greatest number of mistakes in the picture. These cash prizes will be distributed as follows:

First Prize	$500
Second Prize	100
Third Prize	50
Next 10 Prizes, $10 each	100
Next 50 Prizes, $5 each	250
Total Cash Prizes	$1,000

3. Prizes will be awarded to those persons who point out the largest number of actual mistakes found in the picture and who present their explanations of the errors in the clearest and most skilful way. Actual mistakes shall be construed in all cases to mean mistakes appearing in the picture about which there can be no question in the opinion of the judges. In case of ties, the full amount of the prize will be given to each tying contestant.

4. To insure consideration in this month's contest, answers to the picture in this month's issue, published July 10, must be mailed or delivered not later than August 30. No entry bearing a postmarked date later than the closing date for entry will be considered.

5. Answers may be submitted on any kind of paper, but they must be typewritten or written in ink, and on one side of the paper only. Each error must be listed separately and numbered. No changes or corrections will be allowed in any entry after submission, but any contestant may submit as many separate entries as he desires.

6. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth avenue, New York City. Name and address of the entrant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be acknowledged and none will be returned. No letters of inquiry regarding points covered in the rules can be answered.

7. You pay nothing. Just prove your knowledge and observation. You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or you can examine one at any office of POPULAR SCIENCE MONTHLY or at public libraries free of charge. The contest is open to everybody, except employees of POPULAR SCIENCE MONTHLY and the Popular Science Institute of Standards and their families.

8. Officials of the Popular Science Institute of Standards will act as judges and their decisions will be final. Acceptance of these rules is an implied condition of each entry.

They Are All Prize Winners

Some of the Leaders in the March Picture Contest

Second Prize

[illegible]

Third Prize

[illegible]

First Prize

[illegible]

SOME OF THE WINNERS OF $10 PRIZES

Mr. and Mrs. Charles J. Manuel of Perkasie, Pa., with their little daughter. This interesting contest has taught us to study the things about us more intensely—they say

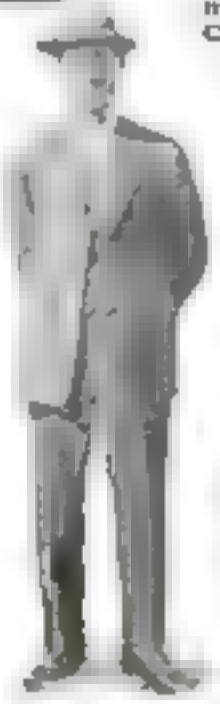
Howard Vincent O'Brien, writer of Winnetka, Ill., and one of his three children. He confesses "a chronic weakness for puzzles"

"My great delight is fixing things that don't work right," writes J. G. des Rivieres, Ottawa Canada. His other hobby is his family

Besides running a garage and machine shop at Ada, Okla., John Cline does considerable flying

At left is a 17-year-old prize winner—Stanley Spinnaire of Mayville, N. D., with his bike"

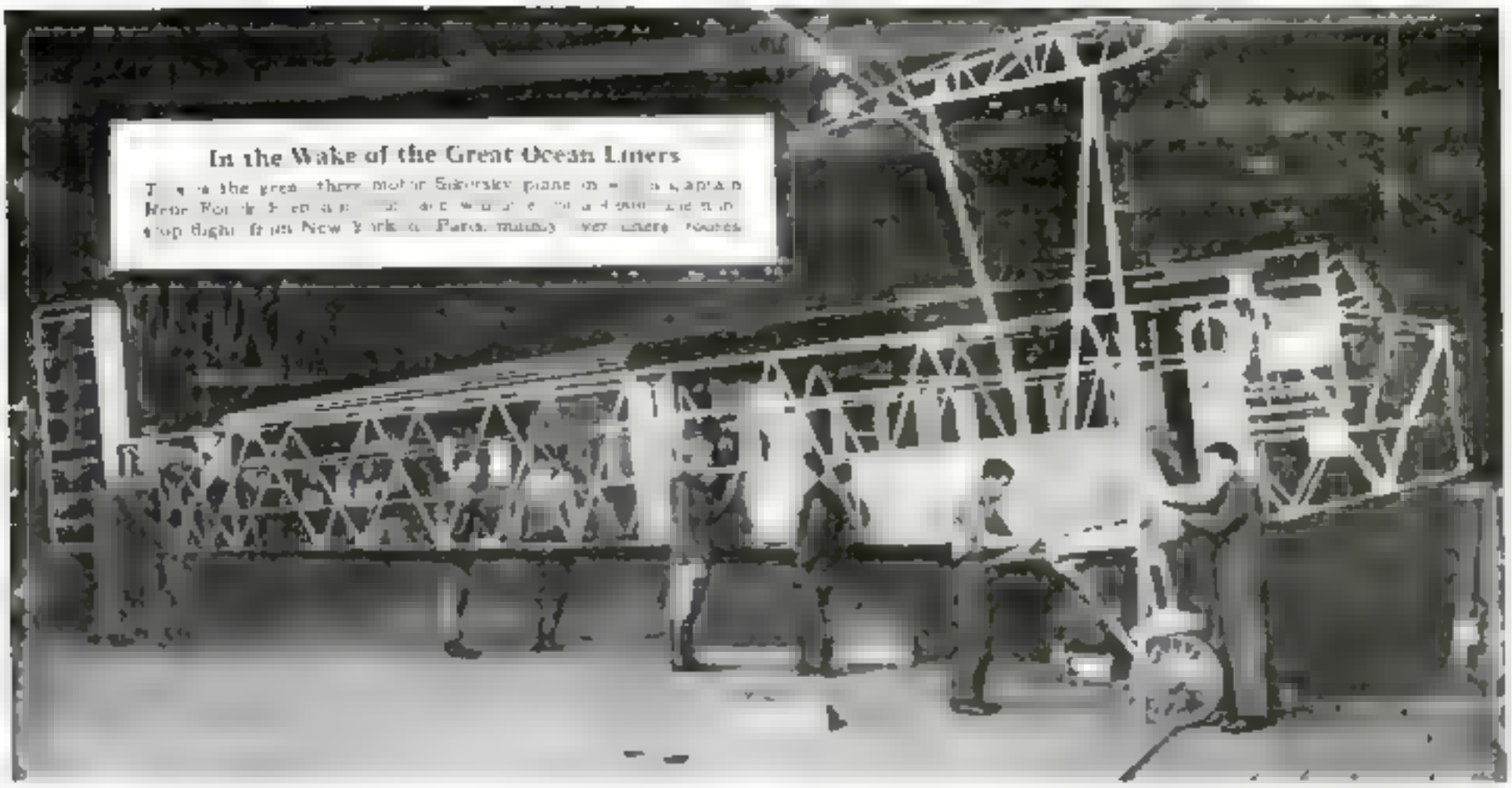
The black cat insisted on sharing the honors with C. R. Helper, a cabinet-maker of Sturgis, Mich.



At right, B. L. Jiron of El Paso, Tex. An electrician, he enjoys "everything scientific"

Fred H. Tanke (left) of Norwood, Minn., fell ill during the Contest. Herman Masseman (right) completed the entry for him

NAMES of all prize winners in the April Picture Contest will appear in next month's issue of POPULAR SCIENCE MONTHLY. *Watch for the September issue.*



TO PARIS BY AIR!

Five Planes in Perilous Race from New York to Found a Nonstop Trans-Atlantic Route

By FITZHUGH GREEN, U. S. NAVY

ONCE more the flying machine is going to dwarf the globe on which we live. Not content with the North Pole, enormous altitudes and crazy speeds, a score of pilots have set their hearts on making the first complete nonstop flight from New York to Paris over the Atlantic Ocean a distance of nearly 4,000 miles in about thirty-six hours of air travel.

This summer's effort to fly the Atlantic is not another stunt. Aviation has graduated out of the circus stage. There is no land to discover, such as Arctic fliers hoped for. In fact, there is neither boon nor bones in the actual flight.

What, then, beckons men to so hazardous an air journey?

We need only to turn to our air mail for the answer. Three years ago plans for a permanent air mail seemed visionary. Now air mail pilots are flying nearly 17,000 miles a day on schedule.

The purpose of the New York to Paris flight plans is to demonstrate the feasibility of a permanent commercial service between these two great capitals. It is believed by experts that in three years at the most daily planes will be passing regularly across the blue seas, carrying mail and, later, passengers.

Five expeditions have been mentioned among those likely to get away before the end of August. Lieutenant Commander Noel Davis of the United States Naval Reserve has been negotiating for a huge Fokker plane to carry him and one companion across. Two of the round-the-world Army fliers have hoped to augment past honors by this new air triumph. One expedition has been kept a dark secret, owing, it is said, to the unique design of plane to be used.

Last, and in some ways most promising, is the flight to be made by Rene Fonck, the renowned French ace, who is said to have had 150 enemy planes to his credit in the last war. The Russian aeronautical designer, Sikorsky, is the builder of Fonck's plane. His engines will be French, his ratio of American design.

This summer's flights will be in the neighborhood of 4000 miles over what is known as the "great circle route." This will take the fliers north along our Atlantic coast and then eastward over the travel lanes of liners. Since there will be no guard ships this plan is essential to the safety of those in any plane that is forced to land in the ocean.

Captain Rene Fonck famous war aviator who now seeks to establish a trans-Atlantic commercial airway

THERE has been some skepticism about the ultimate value of a trans-Atlantic air route even if it is developed. One question is whether such a development would help business or not.

There are more than 200 000 commercial corporations in the United States. Most of them buy goods from Europe. Almost all the big ones sell their services abroad. This means a vast bulk of correspondence and commerce is paper passing back and forth across the ocean. Reducing the time of passage from five or six days to less than two days may make a difference of millions of dollars a year.

Not many people realize the enormous part played by obscure chemicals in industry today. Some of the most important chemicals used in this country are obtainable only from abroad.

It is believed that commercial paper and valuable chemicals alone will make a trans-Atlantic air route a paying proposition from the outset. The flying season would be from April to October. Passenger service would follow in a few years. Dirigibles may ultimately replace planes, but not until they become faster and less fragile than at present.

NOISES You *Never* Hear

There's Magic in "Silent Sounds" That Kill Fishes, and New Wonders in the Ear-Splitting Din of Cities

By E. E. FREE

How Hearing Is Measured

With the aid of this remarkable scientific instrument, a form of the audiometer, our specialists can test the exact condition of the patient's hearing for musical tones of different pitch

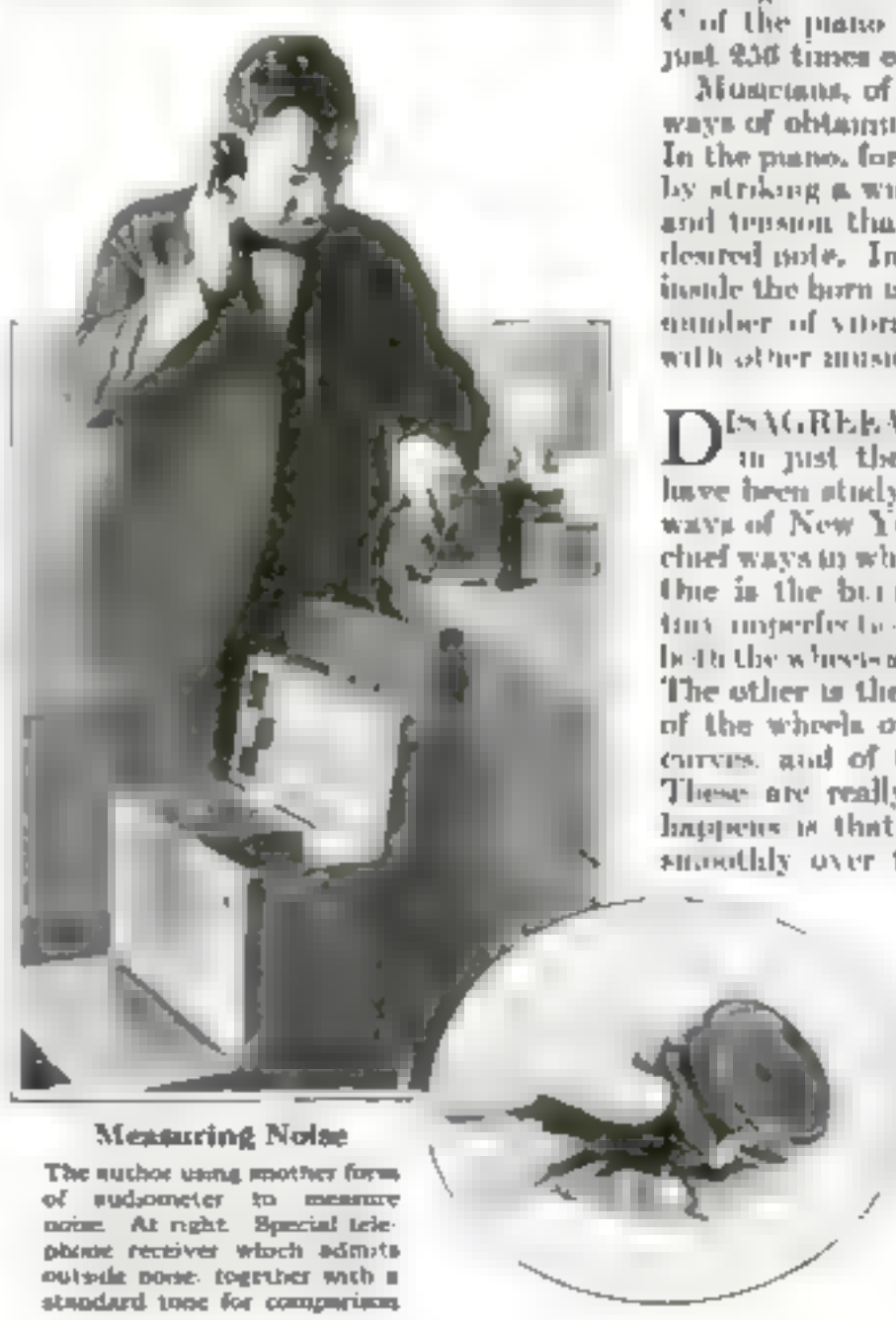
IN CHURCH, while the organ is playing, have you ever felt the pew you are sitting in and the floor beneath your feet begin to tremble with a mysterious sort of rumbling that seems to come from nowhere? Perhaps, a bit startled, you have looked around apprehensively at the walls and ceilings. Then in a moment, you have realized that the source of the strange rumbling is within the church itself—somewhere among the pipes of the playing organ.

What you may not have known, however, is that the vibrations which shake the objects about you are nothing more nor less than sounds. They are really part of the church music: the deepest notes of the organ. Yet, so low are they pitched that while your body can feel them as vibrations, your ears cannot hear them at all.

In fact, all about you, in the noise and hubbub of modern life, the air is full of sounds that you cannot hear. Just as there are notes so low that your ears cannot catch them, others are so shrill that you are hopelessly deaf to them. And did you ever stop to think that everywhere about you, countless creatures may be conversing in shrill languages that you never have heard?

THESE are just a few of the surprising facts which students of sound, within the last two or three years, have been revealing to us. Quite recently, for nearly half a century, scientists did not bother much to experiment with sound. Newer and more striking subjects of discovery such as electricity and radioactivity occupied their attention. Of late, however, many instruments and devices for experimenting with sound have been dug out of dusty storerooms of physical laboratories, where they have lain for many years, and put back into use.

That this is so is due to the increasing importance of the science of sound in modern business, in engineering, and in the promotion of human health, comfort and efficiency. The public, for one thing, is beginning to demand less noise. It is demanding noiseless automobiles and sound-proof houses and apartments. Within a month I have been consulted by at least three business executives who wish, if they can, to cut down the amount of disturbing noises in their offices. Then, with the congestion of traffic particularly in our larger cities, the study of sound is rapidly becoming an important phase of engineering.



Measuring Noise

The author using another form of audiometer to measure noise. At right, Special telephone receiver which admits outside noise together with a standard tone for comparison

ALL sounds are vibrations, ordinarily in the air. If a small boy runs along beside a picket fence and scrapes a stick along the pickets he makes a sound. If he runs fast enough he may even make a musical sound, that is, a sound which has a pitch that any musician can recognize. This pitch is merely a matter of the number of vibrations a second. Suppose the small boy runs fast enough and that the fence pickets are so close together that his stick hits against just 256 separate pickets in a second. That will send out a sound wave which vibrates just that many times a second. The pitch of this wave will be recognized by a musician as middle C of the piano. Putting it the other way around, middle C of the piano is a tone which vibrates just 256 times each second.

Musicians, of course, resort to simpler ways of obtaining the sounds they want. In the piano, for example, the pitch is got by striking a wire string of such a length and tension that it will vibrate with the desired note. In a horn the column of air inside the horn is made to vibrate with the number of vibrations desired, and so on with other musical instruments.

DISAGREEABLE noises are produced in just the same way. Recently I have been studying the noise in the subways of New York City. There are two chief ways in which this noise is produced. One is the bumping of the wheels over tiny imperfections in the rails, which sets both the wheels and the rails into vibration. The other is the screeching and grinding of the wheels on the rails, especially at curves, and of the gears on each other. These are really vibrations, too. What happens is that the wheel does not slip smoothly over the rail but moves in a series of very tiny jumps. For an instant the wheel and the rail cling. Then they pull loose and the wheel moves. Then they cling again, then pull loose again, and so on. A dry bearing does the same thing when it squeaks. A shovel on a cement floor behaves simi-

larly. The scraping sets it to vibrating. You can even tune your shovel and make it sing a note as you scrape it along. Mostly, however, what you get is a mixed, disagreeable tone. Possibly some day an enterprising hardware merchant will devise a musical shovel that will sing to you as the ashes go out.

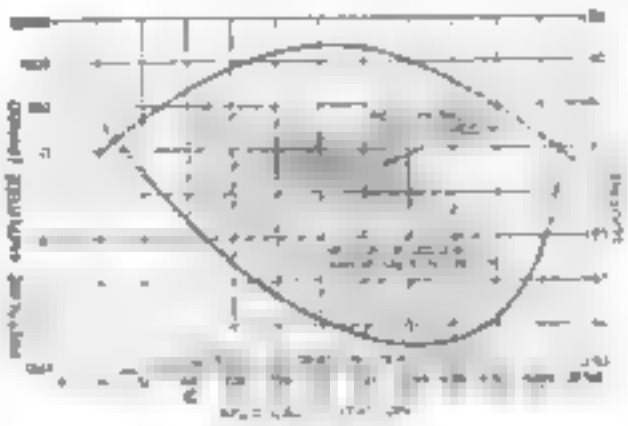
THE thing that causes the deafening noises in places like a subway or machine shops where hundreds of pieces of machinery are running, is that our ears are assaulted by thousands or even millions of different vibrations all at once. A single subway wheel might sing with a not unpleasant tone. But the fifty or sixty wheels on a train are singing at the same time, all with different notes. Also, the teeth on the gears inside the gear boxes are singing. The rails are singing. The result is, not musical tones at all, but noise. Noise is simply mixed sounds, a hundred or a thousand separate tones at once. If dirt is matter out of place, noise is music out of order

This can happen even with real musical tones. Years ago, when I played in a band, the leader had a habit of passing around the number of the next piece on a slip of paper. Once the next number was six. But the leader forgot to underscore it. Some of the bandsmen read it right side up, which was proper. But a few of us read it upside down and got ready to play number nine, which, when the time came, we did. No one who heard the result could doubt how easily music can degenerate into noise.

When we begin talking about the effects of noise on modern civilization the first thing we have to know is how much noise there really is. Last year, when someone asked me how much noise there was on the streets of New York City, I determined to find out. It happened that the scientists of the Bell Telephone Laboratories, in New York City, had developed an instrument which, although devised originally to measure the amount of hearing lost by partially deaf people, could be used conveniently to measure noise.

Niagara's Roar Rivals Busiest Street Corner

Measuring the noise at the brink of the Canadian Horseshoe Falls of Niagara, with the aid of the audiometer. The instrument recorded fifty-five units—equal to the noise of New York's busiest street corner. This measurement is classified as "mildly deafening"



Sounds We Can Hear

This diagram shows the range of sounds, both in pitch and in loudness, which are audible to the average human ear. Tones lying below the bottom curve are too faint to be audible. Those above the top curve are felt as vibrations, but not heard. The small tones which are inaudible to our ears lie to the right of the inclosed area

With one of these instruments I made a noise survey of the metropolis. The result was the discovery of valuable new facts concerning many of the common noises heard in virtually every large city.

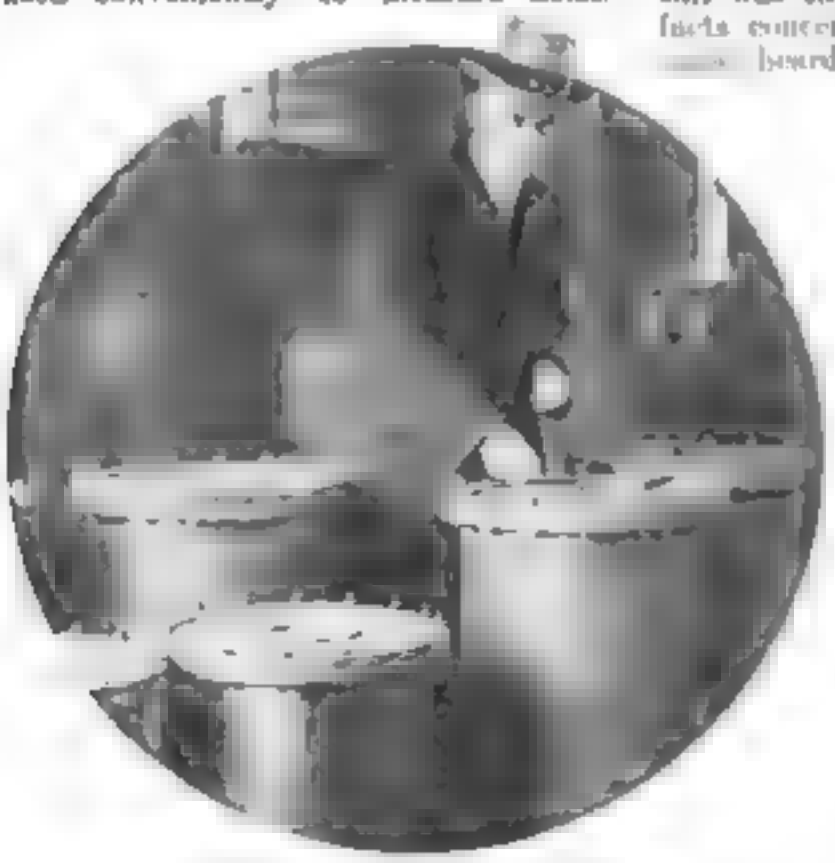
One of the most interesting of these is that the amount of noise is extremely variable in different places in a city even if the places are close together. Many people think that great cities are blanketed everywhere with a great pall of noise that no one can escape. This is quite untrue. There is, of course, a low general hum which one can hear everywhere, but this is not troublesome even to nervous people. The really troublesome noise of a city is due almost altogether to the traffic on its streets. This traffic is variable. One street with heavy traffic may be very noisy. A block away where traffic is less, the noise may be as low as in a country town. This means that anyone disturbed by the noise in his neighborhood probably can find relief very close at hand. In many cases all that is necessary is to move from a front room into a back room

Another curious fact is that the two sides of a street may differ widely in the amount of noise they receive. A plain, blank wall will reflect more street noise against the opposite building than will a building with its front broken up by many windows or ornaments.

IN MEASURING city noises we use a system of units which are related to the effect of the noises on the ear. The average human hearing is rated at one hundred units. Thus, if a man is half deaf we say that he has lost fifty units of his hearing. These same units are used to measure noise. For example, at the noisiest street corner I found in New York at Sixth avenue and Thirty-fourth street the noise was measured as fifty-five units. This means, approximately, that when you stand at that corner the noise deafens you to about the same degree as if you had lost fifty-five percent of your normal hearing. In machine shops and factories, or close to a laboring automobile truck, or inside an empty subway car, I have known the noise intensity to rise to ninety-five or a hundred units, which means that a person with normal ears, not accustomed to the noise, will have practically no useful hearing left at all.

Curiously enough, the quietest place found in all of New York City, or in any city for that matter, was in the subway. It was on the platform of a station when no train was passing or near at hand. Being underground, no noise came down from the streets. The quiet was almost perfect. Then just as we finished the test, a man came in and rustled a newspaper. Instantly the noise level jumped to that of a quiet suburb, so greatly did the rustle reverberate between the smooth walls, the ceiling and the floor

An interesting thing about noise in street cars, automobile busses and railway trains is that the noise is much less when the vehicle is loaded than when it is empty. This is due to (Continued on page 110)



He Predicts a Noiseless World

Hiram Percy Maxim, famous inventor and radio expert, with silencers he has devised for motors and other machines. He believes they may result in producing a noiseless world

The Boy whose Big Feet *Paddled Him to* FAME

By CRAG DALE

Swimming with head and feet up develops the arch in the back that cuts resistance in the water says Weissmuller. *Far left* The champion, poised for the gun at the start of a race

A Triumph of Muscular Coordination

Weissmuller "says Coach Bachrach, "has the great gift of muscular coordination." Because of this and also because he can think when racing and also because his feet feel snug in No 11 shoes the kid from Chicago owns today more than half the world's records for men's free style swimming

LARGE feet have had much to do with giving Johnny Weissmuller the right to call himself, and to be proclaimed, the world's premier swimmer. Even as a kid, out at the Larrabee street Y. M. C. A., Chicago, where Johnny first began to attract attention from swimming coaches, his feet stood him in good stead, for in them the coaches saw the "paddles" that might enable him to develop into the fastest swimmer in the world before he even reached maturity.

And Weissmuller has done just that!

More than half the world's records for men's free style swimming were owned and controlled by the big footed, long, lean lad from America when the last statistics were made public by the International Amateur Swimming Federation in 1925. Since that time Johnny Weissmuller has added to the list, and has mastered the backstroke, establishing new records in that classification.

According to the Amateur Athletic Union of America, in its latest publication of records, which cannot keep up with Johnny's smashing six-beat, double trudgeon crawl stroke, he holds thirty-two out of sixty records for all individual swimming efforts, and certifications of additional forays into the sixty are now in the hands of the Union, and have been favorably acted upon. Among them is the amazing time of fifty-one and one fifth seconds for the 100-yard free style event, which cut his previous world record time by one and one fifth seconds. The new time was made at the Cleveland Athletic Club, January 29, 1926.

Perhaps a better idea of Weissmuller's swimming achievements can be arrived at by recalling the fact that it wasn't so very long ago that Charley Daniels of the New York Athletic Club startled the sports world by doing the 220-yard free style event in two minutes, twenty-five and two fifths seconds. Then Norman Ross came along and clipped five seconds off that record, which was considered considerable swimming for anything but a fish.

It remained for Johnny Weissmuller to do the 220 in ten seconds less than Ross, making the record time of two minutes, ten and two fifths seconds, on January 7, 1926.

Although this is not a narrative of Weissmuller's championship achievements, the telling about those records is rather essential to an understanding of the youthful personality that accomplished them.

Despite the honors and pounds of medals that have been heaped upon Johnny Weissmuller, he is, at twenty-one years of age, the same unassuming youth who walked into the Larrabee street "Y" with the gang from North avenue on a spring day in 1919. Except for his height, there is nothing about him, as he walks down Michigan avenue, to enable the passer-by to spot him as being any different from the scads of other twenty-one-year-old boys on the boulevard. In his talk he is quiet, dignified, and without conceit, yet fully conscious of his swimming abilities and of his limitations.

Back in 1919 Johnny was like all the other boys in the North avenue neighborhood which was adjacent to Lake Michigan. He had spent much of his time swimming and playing about in the lake and he was good then.

"I WATCHED the life guards, and all the good swimmers," he explained to me, in telling how it all started. "I copied the strokes from all of them, until I guess I didn't have any style at all. But I must have got something from it, for I could swim pretty fast for a kid. I had been at it ever since I was eight years old, when I taught myself how."

Some of the gang with which Johnny traded then are now in active work at the same "Y" and they explain that Johnny, even with his crazy style, could beat any kid on the beach except one "Hooks" Hugo Miller, and that it was Johnny's driving ambition to beat "Hooks" that really started him on his way to swimming glory. Though it was mighty hard for Johnny to dig up the twelve dollar fee for the "Y" membership, he did it. Johnny, himself, gives "Hooks" indirect

Johnny Weissmuller, Greatest of Swimmers, Tells How to Master His Crawl Stroke

credit for his success, in that it was "Hooks" who later, now no longer a brilliant swimmer, put his friend on the right road to success by introducing him to Coach William Bachrach, swimming trainer for the Illinois Athletic Club. And that was just at the moment when Johnny, broken hearted and dispirited, was about to relinquish his championship hopes.

But, let Johnny tell it.

"At first they didn't pay much attention to me out at the 'Y.' I was just one of the kids. I kept going into the pool, though, and trying to beat 'Hooks.' He was older than I was, and a better swimmer. I really wasn't in his class. The coach out there, a fellow by the name of Crawmer (H. W. Crawmer, now in Des Moines), one day said something about my big feet and long arms, praised my speed, and put me on the same team with 'Hooks' for the Amateur Federation meets.

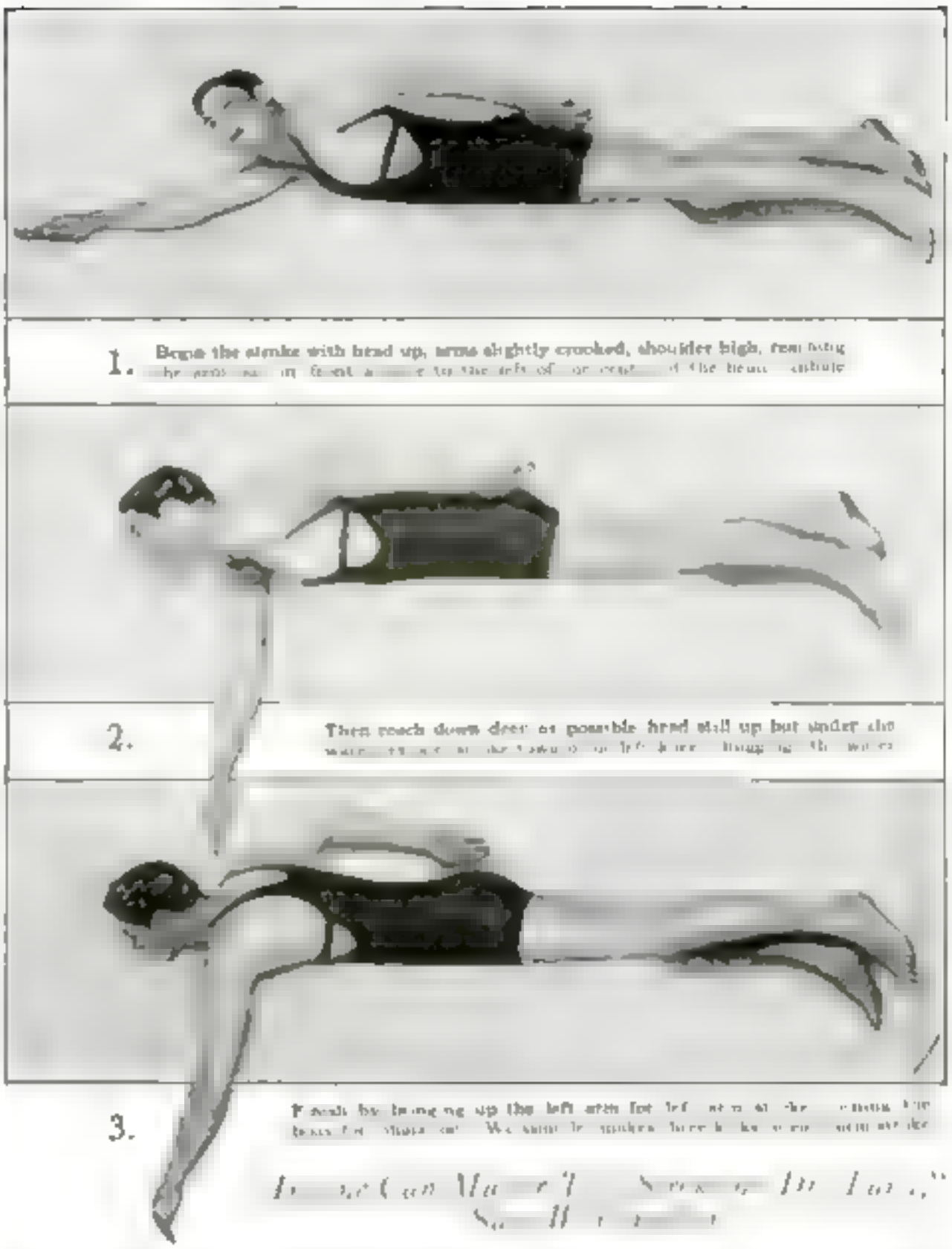
"WE WON. We won the city championship for Intermediate swimmers that year, and the shield trophy that we took back to Larrabee street is the first emblem of my swimming success."

As to just how he became good enough to swim with "Hooks," Johnny is not clear in his memory. He gives constant practice as the real reason, and attributes nothing to native ability. At any rate the desire to be a great swimmer was so overpowering and so much time was necessary for practice that Johnny cut his school work short and was rejoiced to see the end of his second year at Lane High School, so he could stop school entirely and spend more of each day in the pool.

Now, in the light of later years, there is

Like the Fins and Tail of a Fish

This remarkable photo suggests that Weissmuller learned his art from the only real swimmers



1. Begin the stroke with head up, arms slightly crooked, shoulder high, reaching [illegible]

2. Then reach down deep as possible, head still up but under the [illegible]

3. [illegible]

[illegible]

the dawning of regret in Johnny's mind for that decapitated schooling, but he is trying hard to make up for it by his application to books.

"I read a lot," he explained, "and since I have been in competitive swimming I have traveled a lot, seen much, listened much, met many. I am learning all the time.

"AND" he added as if in complete justification for his defection from high school, "I am swimming better all of the time. I don't have to spend so much time in the water now, because I have got the form down right; but it used to be from ten o'clock in the morning until ten-thirty at night for me—swimming hard most of the time.

"How did you conquer the form?" I asked.

"Oh, Bachrach did that. He's a peach. He started right in on me when I first came here. I had sort of lost hope then, because trainers at other clubs had not paid much attention to me. The worst of it had been when the coach at the Chicago Athletic Club put me up against a finished swimmer, and I got beat. It wasn't the beating I minded, for I had been beaten by 'Hooks' lots of times. It was the way it was done. Why, I didn't even know how to turn in the pool. I would crawl out of it at every turn, losing five seconds at least. I was a clown, but at that he only beat me by about so far"—and Weissmuller extended his two big, flat hands with their long, tapering fingers, to indicate a space of about four inches.

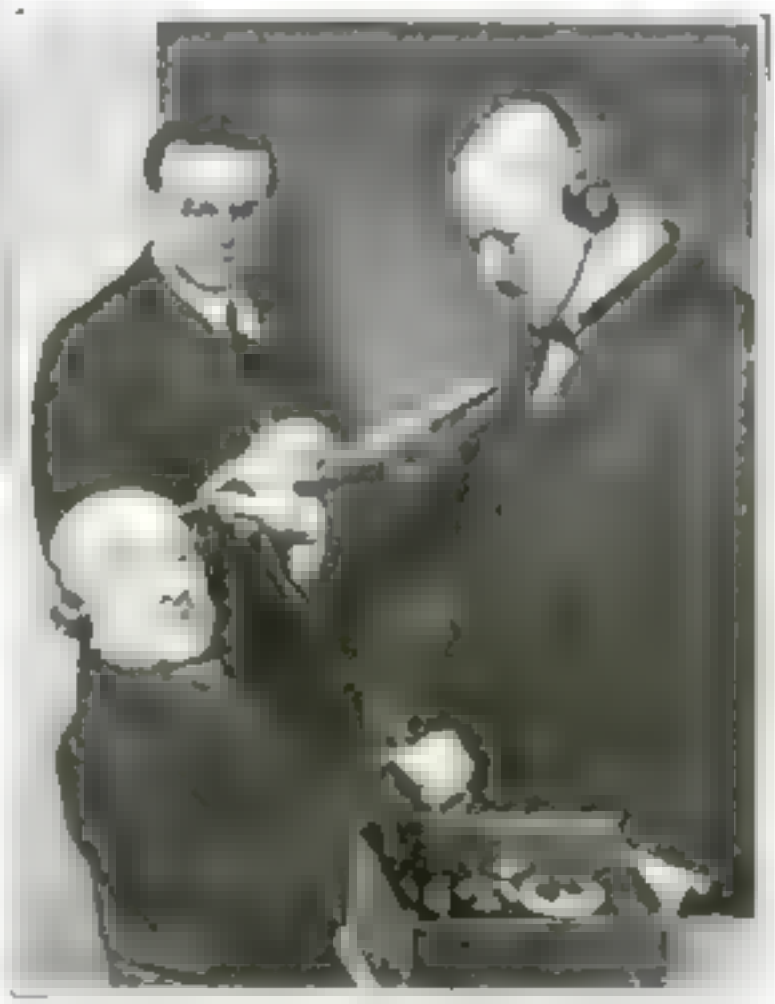
"Nothing was said to me—no word of advice or correction. I was just let alone and I tell you that pretty nearly took the heart out of me. I told 'Hooks' about it one day and he asked me if I really wanted to be a great swimmer. When I told him I did, but that I didn't know which way to move next, he said, 'All right Johnny, you come with me. I know a fellow who will take an interest in you.' And without another word about it he brought me down here to Bach.

"BACHRACH got right after me. He taught me to get in an extra kick," and he smiled boyishly as he lifted his number eleven shoe to show what an extra kick might mean. "He taught me how to pull the water with my hands so that I could get more power from each stroke. He made me throw my right shoulder higher, and helped put an arch in my back that enables me to swim with the least possible body resistance to the water.

(Continued on page 106)

Do You Choose Your

People with Bulges at the Back of the Head Make the Best Ones, Say Some Students of Character Reading



WHEN I was a growing boy [illegible] was to be a policeman. Occasionally I wavered in my decision and permitted myself to be tempted by the glittering prizes of the life of a fireman or motorman, but not for long. Just about the time I was convinced that the policeman's job suffered by comparison with those of Jess Jack Hersey's father, his brass buttons shining and his shoes reflecting the sun, came strolling down the street, swinging his club, and I got temperature bored me. My chosen vocation was that of the guardian of the law.

But when I grew up to real manhood that is, when I started on my first job as office boy I realized how ridiculous were my early aspirations. Policeman, pooh! There was only one worth while position and that was as an executive.

To be sure, my ideas of the duties and responsibilities of an executive's post were a little hazy. In fact, I doubt if I gave them a single thought. But on my infrequent visits to the private office of the head of the concern, I stood there gazing fascinated at the long row of buttons that it was his privilege to push, and knew that here was what I wanted. An immense flat-top desk covered with plate glass, a swinging chair capable of being tilted back, and those fascinating buttons. My fingers ached to press them.

Yet though many years have slipped past I am not much nearer that goal. I am still on the responding end of the buzzers. And I was beginning to despair of ever attaining that objective until I started investigating phrenology. To my great delight I discovered I am an executive, with forty-two buttons at my command. So are you. A bit skeptical, are you? Listen.

Instead of the brain's working as a unit, phrenologists say it operates as a team, or a business concern with many departments—forty-two, to be exact. Each of these departments has its own province, and when it is flushed with its share of the work on hand, it passes it along to another division. And you, the individual, are the executive. You press the buttons—and the departments automatically respond.

These forty-two departments cleave in a row through the center and thirty-one pairs are there—one side to cover the whole range of mental activity. No matter what kind of a thinking job you may have to do, there's a subdivision to handle it. If Nature has been kind and given you a good mental equipment to start with, and you have been a good manager and have trained your departments well, the action of reaching for the buzzer and the response of the department will be automatic.

Although to the touch the skull seems quite hard and permanently shaped, phrenologists assert that it is capable of growth. If the kind of work you do calls into play one of these departments much more than the others, it will, it is said, enlarge, and the skull will be forced out at that point. That's why the claim is made that character can be judged from the shape of the head. If, let us say, you are a spiritually minded person your department of veneration will increase in size through use. A glance at the chart on the opposite page will show that the region of veneration is located at the top of the head. A phrenologist, skilled in examining skulls, will notice this enlargement and be able, if the science is correct, to inform you of your characteristic even though you may be a complete stranger to him.

On the other hand, you may press one buzzer so seldom that cobwebs form on that department's walls and it shrivels up. I'll take a purely hypothetical case.

A college professor, a shy, retiring young man who has spent most of his life among books, attends a social affair given to the faculty and is introduced to a charming young woman. He is tremendously impressed by her beauty and personality, with the result that he immediately is smitten. According to phrenology, this is the way his brain departments worked:

When first apprised of the young lady's presence the professor pressed his buzzer and summoned the department head of Inhabitiveness. Thus, as the chart will show, is in the forehead just above the nose, and its sole purpose is to inform the proprietor of the existence of an external object. He then summoned Form which gave him an idea of the lady's figure. Then Size, Weight, Color. All of these taken together gave him a very pleasant picture.

HE REFERRED the whole matter to Comparison, which told him that in all his life he had never seen one so fair, so well proportioned of a height to match his own as well. He began to experience some quakings that heretofore he had never been subject to. Bewildered, he put in a call for Amativeness, which, you will observe, is in the back of the head just above the collar.

Ross a Amano
seen a forehead bulges at the spot that phrenologists call the seat of locality in the picture indicated by the highlight in the middle of the forehead. Thus they trace directly to the explorer's keen sense of direction

Here was a department head that had been slumbering undisturbed for years. He responded quickly enough to the summons, and did his best to carry the

Friends *by Their* Bumps?

By William J. White, Jr.

message to the young lady's mind. But his argument was weak, and the lady repulsed him with scorn. The professor pressed the buzzer again. Amativeness tried to answer, but collapsed in the effort.

The stricken young man was not to be denied. He changed his tactics and buzzed Agreeableness, using that department to such good advantage for the rest of the evening that the lady granted him permission to call the following week. Meanwhile the professor forsook his books and started to clean up Amativeness' office and get the head of the department in training. So well did he apply himself to the task that a year later the couple stood up to say "I do."

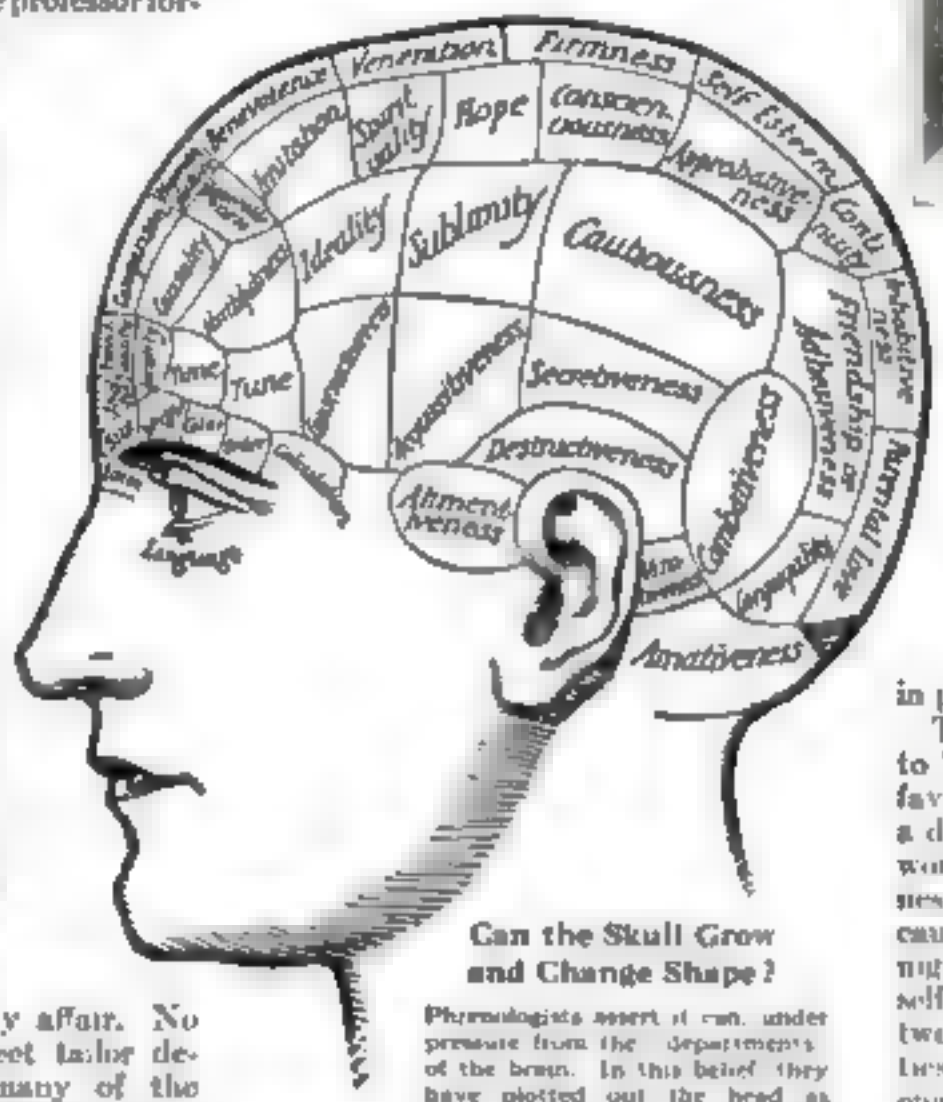
I MENTIONED that faculty—the phrenologists' designation for the departments of the brain—of amativeness first, because I gave that the initial test. It furnished me with the solution of a mystery of many years' standing. Why I have often wondered, does a certain male acquaintance of mine make such an instantaneous impression upon virtually all women he meets?

He certainly would not last through the preliminaries of a contest to select an American Apollo as a team mate for the winner of the annual Atlantic City affair. No Fifth avenue or Bond street tailor designs his clothes. And many of the niceties of social conduct regarded as so important in the Book of Etiquette are entirely unknown to him.

Yet, despite these shortcomings, he was a walk over other men. Naturally I thought of him when I had progressed far enough in my study of phrenology to learn that the sign of the great lover is a pronounced development at the back of the head just above the collar. I traced my friend around for inspection and sure enough, the sign was there in extra measure.

It's very easy, then, to follow the processes of phrenologists by which they arrive at the conclusion that character can be gaged from the shape of the subject's head. It would not have required an expert to determine my friend's great weakness (or strength, whichever way you look at it) once having seen the back of his head.

They deny, however, that the bumps alone are the bases of their analyses, claiming to be able to analyse a person whose head is as round as the proverbial billiard ball. It's the shape of the heart—measured with an imaginary compass that uses the opening of the ear as a center—that counts in phrenology.

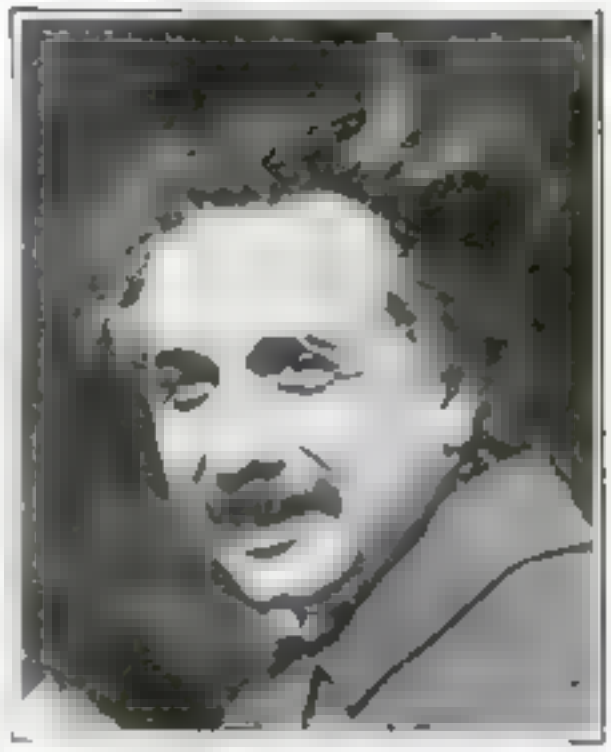


Can the Skull Grow and Change Shape?

Phrenologists assert it can, under pressure from the departments of the brain. In this belief they have plotted out the head as shown here. Do you think you could identify your "bumps"?

The science—as many insist it is—had its origin toward the end of the eighteenth century and was the result of great acuteness of perception in a German schoolboy named Franz Joseph Gall. At an early age he made the discovery that his schoolmates who showed great ability in the study of languages invariably had prominent eyes. That gave him the idea on which phrenology is based—that there is a special place in the brain for each faculty.

Gall took up the study of medicine, and after graduation devoted part of his time to his theory. Later he gave up practicing his profession altogether insofar as it conflicted with his investigations. From hospital to asylum to prison he journeyed—analyzing, measuring, questioning. The result of many years of this was phrenology, pretty much as it is today. He established the location of twenty-six faculties, while subsequent investigators have brought the number up to forty-two.



Prof. Albert Einstein, expounder of the Einstein theory, has a head which, phrenologists say, bears out their contentions. It is unusually wide at the outside of the eyes—the seat of calculation

How many times have you had dreams in which there is no sequence? One moment you are at home, seated at the table eating dinner, then without warning you are suddenly transported to your office, where you are telling the boss that you simply won't work another day without a large increase in pay. Everybody has such dreams.

These phenomena of dreams are held to be one of the strongest arguments in favor of phrenology. In the case of such a dream as given above, the explanation would be that your faculty of wakefulness refused to go to sleep, possibly because you went to bed without your nightly snack, and that the faculty of self-esteem was also wide-awake. These two, lacking the assistance of other faculties needed to make the dream cohesive, enabled you to cover the distance from home to office in less than an airplane time. Or it may happen that three or four faculties having no co-ordination will operate at the same time, producing a nightmare.

ANOTHER argument in favor of the theory is the prevalence of monomania. A person may be rational on every subject but one. He may insist, for instance, that there is a plot afoot to poison him. That, phrenologists say, is occasioned by a diseased condition of one of the brain faculties, possibly, in this instance, of alimentiveness. Cases are common in which the removal of a growth on a part of the brain has restored the patient to normalcy.

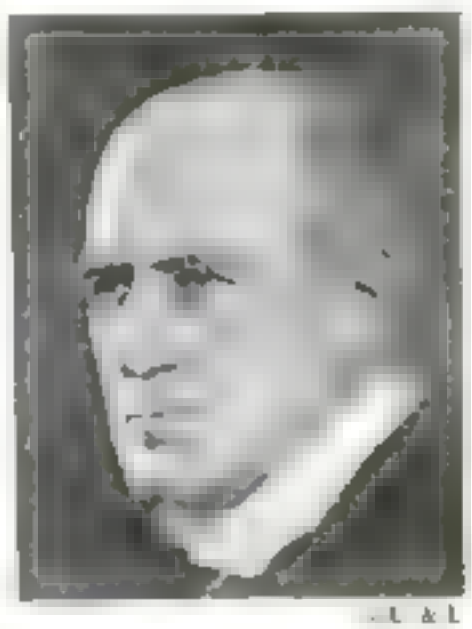
In the front section of the brain are located the intellectual faculties. A close examination of this, it is said, will give you an accurate idea of the amount of intelligence possessed by the subject. The chart shown on this page will aid you in locating these centers.

Between the eyes, on either side of the nose, is the sector called form. It is supposed to give the possessor the ability

WHETHER you believe in phrenology or not, this article telling how its practitioners read character from the shape of the head is sure to interest you. Though scientists generally do not endorse it, the subject always has fascinated the layman.

to recollect faces, figures, buildings and the like. Unusual development tends to push the eyes apart, producing the wide-eyed character so favored by fiction writers.

Directly above form is size. It is situated on a line with the eyebrows. If you are deficient here you would make a poor marksman or photographer, two activities in which accurate estimate of distance is essential. Extending to the ends of the eyebrows are the faculties of weight, color, order, and calculation. Weight includes judgment of balance, and it follows that it would not be advisable for anyone who is poorly developed in that area to essay a wire walking act in a circus; while a man deficient in color would never do as a railroad engineer, since, we are told, he would probably be color blind. Calculation will, it is said, be found large in mathematicians.



They Shaped Their Own Heads, Says Phrenology

Will Rogers has certainly been a funny man long enough to have some evidence of it on his cranium, if phrenology is right. The seat of mirthfulness is above the outer edge of eyebrows. Do you find it?

Charles Dana Gibson, the noted artist, would bear out phrenologists on at least one point. The wide-apart setting of his eyes, they say, indicates the high development of his faculty of form

RIGHT above the bridge of the nose flanked by form and size is individuality. This is the primary faculty of perception. By means of it, phrenologists say, you are able to recognize external objects and form ideas from them. The more it is developed the more observant you are. Individuality, however, has no power of classifying. It will tell you, for example, that the object in front of you is a house, but color will modify that by explaining it is painted red.

Now comes the second row in the group of intellectual faculties. They are eventuality, locality, time and tune. The first named is the seat of the memory of events. Reporters should be well developed here. You should find it unusually large on persons whose stories run: "It was three years ago last July twelfth—a Thursday, I remember at about quarter after nine in the morning—"

All of these faculties, we are told, are capable of growth, or may become almost atrophied through disuse. That may explain why Captain Miles Standish pressed John Alden into service as an ambassador of love. Captain Standish, a military man, undoubtedly had more than the ordinary allotment of order, because of his military training, but the rough and ready atmosphere of soldiers' camps and frontier settlements was not ideal for the fostering of the love faculty.

LOCALITY, as the name implies, is the sense of place. It's an absolute necessity for explorers and navigators.

Seeking to find some evidence to confirm this location of that rather rare quality, I visited one of my old army buddies who had charge of a roving detachment in an infantry regiment. As any veteran of the A. E. F. who saw service near the line will attest, maps were as scarce, almost, as finger bowls at the front. Fortunate owners of these treasures guarded them with jealous care, tenderly scraping accumulations of mud from the surface, planting them out to dry during the infrequent glimpses of the sun.

The table of specifications, unfortunately, neglected to include the unit of which my friend was in charge, among map recipients. He had to blunder his way about as best he could, with an occasional hasty glance at a friend's map.

Yet I never knew him to get lost. I've seen him come upon detachments whose leaders pondered over their maps trying in vain to orient themselves, and with a tactful word or two—for he was a non-commissioned officer—set them straight.

Possibly I wanted to be convinced, and saw something that didn't actually exist, but I'm sure that his forehead is quite prominent at the place where phrenologists say locality lives.

Time needs no explanation. Look for the faculty among your friends who, when they say eight-fifteen, are to be found at the appointed spot at eighteen. Tune, according to this theory, will be well developed in the foreheads of musicians.

NEXT are the seats of the mighty faculties, comparison and causality. When large these give the brow a lofty appearance; they are responsible for the high-brow.

Comparison is supposed to give the power of making decisions through contrast. It is the poker of your brain. By means of it executives arrive at conclusions that make them famous; the same sector of the farmer's brain tells him what to plant in the north field.

Causality is the sector of pure reason. A man who is well developed here is not only capable of plumbing a question to the very bottom, but will render a judgment that is unbiased and free from sentiment. Phrenologists tell us that judges who seem at times rather cold-blooded in their decisions probably depend to a large extent upon causality, whereas the "human" judge who makes allowance for certain failings brings the human nature faculty into play as well.

Above tune is mirthfulness, or wit, and its size is said to be a gage of your sense of humor. It gives the head a broad appearance just forward of the temples.

Few of the faculties in the central section of the brain need any explanation. The higher qualities are at the top of the head and forward of a vertical line drawn through the ear. Just above that organ is the faculty of destructiveness. Its presence to any great degree gives the head a broad, flat appearance, an animal-like shape.

Just forward of the ear, is your mental appetite, alimentiveness by name. When this is abnormal in size, we are told that it is the sign of the glutton, whereas persons deficient in that faculty are very porky eaters.

Rendering too hasty a judgment recently got me into a most embarrassing position. At a social gathering, called upon to do a parlor trick, I chose to give an exhibition of my skill as a phrenologist, since I was engaged in my research into the subject and therefore quite full of it. A young man whom I had just met was placed before me as the victim. Most of the others present knew him well, and were in a position to judge of the accuracy of my findings.

THE very first thing I noticed as I glimpsed his profile was a pronounced protuberance in the region that the phrenologists ascribe to alimentiveness. Naturally I did not like to accuse him of being a glutton, but as delicately as possible I hinted that he was rather fond of his meals. At that there was a general roar of laughter. It developed that a moment or so before I arrived, quite late, my subject, who had just preceded me, had apologized for his own tardiness by explaining he had been to the doctor in search of a tonic to bolster up an appetite of unusual proportions!

And when the young man turned his full face toward me I saw the reason for my mistake. I had mistaken his faculty of alimentiveness for the beginning of a common ordinary bowl!

VITATIVENESS, located behind the ear, is said to denote a great love of life. Continuity is your power of concentration. Great development of it gives the head an egg-shaped appearance. Learning that, I was reminded of an editor under whom I worked some years ago, whose head had that conformation. It was almost necessary to shake him by the arm to get his attention whenever he was absorbed in a piece of work.

The above brief resume covers in a general way the "science" of phrenology. Equipped with the chart and a fairly accurate eye for gaging distances, you are in a position to test its accuracy.

But, if you select a prize fighter as a subject, don't make the mistake of assuming that the bump on the back of his head, caused by a violent contact with the floor of the ring, is the faculty of self-esteem. He may be resentful and prove to you in physical fashion that his destructiveness faculty is above normal.

A Godfather of Inventors

To John Stevens We Owe Our Patent Laws and Wonders of Transportation

An inventive genius who saw far beyond his own times was Colonel John Stevens. He caused the passage of the first American patent laws, built the first American steam train, and produced the screw propeller the iron-clad ship, and also the first modern projectile

By Archibald Douglas Turnbull

The Birth of American Railroads

"Trains will be making fifty miles an hour some day," predicted Colonel Stevens, as his puffy little locomotive, the first ever to run in America, circled about on its wooden tracks at Hoboken, N. J., 100 years ago

IF EVER we had a Centennial year, marking truly American inventive enterprise and progress, that year is 1926. For just a hundred years ago, almost to the exact minute, genius and vision stood revealed before a small crowd gathered upon a green New Jersey lawn.

In that whispering body were the idle, whiling away an hour; the really interested, debating the outcome, and, of course, the sneeringly skeptical. Yet, among them all, not another could peer far down into his country's future as did the keen, gray eyes of the man who stood in the centre his extraordinary mind perfectly aware of what he was about to do. Had others been blessed with such far-sightedness, that crowd would have murdered its thousands, roaring themselves hoarse over the most important birth in the American commercial nursery.

EVERYONE, of course, could see that two concentric circles of narrow wood had been laid down upon the lawn and everyone could see the platform on wheels that bridged those two circles. Many, too, must have recognized that the contraption on the platform represented a boiler and a steam engine. Presently, they heard the crackle of a wood fire and saw a puff of smoke; next, their ears caught the sputter of steam in the piping. Then—the outlandish contrivance began to move.

Slowly at first, but gathering speed as it went, the little monster followed the wooden circles, came back to its starting point, and went around again and yet again. The first steam train ever to run upon rails on the American continent was an accomplished fact, and the man who built it was Colonel John Stevens, of Hoboken.

THE crowd stared—rubbed its collective eyes—and stared again. Could it after all be true, as John Stevens for years had been insisting, that *this* was the way to get farm produce to city markets, *this* the way, too, to mobilize troops on the country's frontiers in emergency, and *this* the greatest cornerstone of America's economic success?

Some may still have doubted but some at least, were convinced. Within the year, the eastern legislatures were besieged for railroad charters. Within a few years more, axes were slashing out new rights of way while pick and spade were ringing upon loose stone or buried boulders in an enterprise which has never stopped since. Today, American railroad mileage would belt the world a dozen times. But every inch of shining steel ribbon, every acre of jammed freight-yard, every lumbering box car and every thundering Limited Mail date back to John Stevens' puffy little affair, first feeling its way gingerly, then working up to five, six, and seven miles an hour. The fight that he had so long made, single-handed, was won on that never-to-be-forgotten afternoon of 1826.

STRANGE that the man who did this thing should have had no more prominent place in American history? It is strange, and there are but two reasons for it. First, there was the singular modesty of his descendants, who sought no public notice of his record. Second there was his having inherited a good-sized fortune from his distinguished father, a fact which lifted him out of that class of gaunt and hungry-eyed inventors whose struggles for recognition have always interested the biographer and the historian.

Yet John Stevens was an inventor, not only a great one, himself but as it were, the godfather of all others in America. As far back as 1789 he petitioned Congress for protection for inventors, under the Constitutional provision for encouraging "Useful Arts and Sciences." In consequence of that petition the first United States patent laws were passed. And so there never has been an American inventor since, who did not owe some share of whatever success and fame he won, either in his lifetime or at the hands of posterity, to John Stevens.

NATURALLY, he was not wholly unselfish in asking for patent laws. In the last decade of the eighteenth century, he had cast aside his early training for the law, forgotten his business career as Revolutionary Treasurer of the state of New Jersey, and gone in, heart and soul, for engineering. Largely self-taught, by studying every existing authority and every experiment known at the time, he set his face toward devising improvements. On the land he had bought in Hoboken—practically the whole tract that now forms the city—he

The original twin screw propeller designed by John Stevens and used by him on the Hudson river almost a century and a quarter ago when other inventors were experimenting with paddle wheel boats. Note the amazing resemblance to the propeller used on all our modern steamships

built himself a small shack, at some distance from his house upon the hilltop. In that shack he studied his problems, making his own calculations and his own drawings. Very soon he was assisted by two eager sons, Robert, destined to become the nation's leading naval architect, and Edwin, a rare combination of inventor and business man.

IMPROVEMENTS began with boilers, of the multi-tubular type. By saving space and weight, without loss of heating surface, this was a distinct advance over both the simple cylinder and the long, single-coil pipe of James Rumsey, of Virginia, who had experimented with steamboats as early as 1785. For one such boiler, made small for experimental purposes, Stevens used old musket barrels, their ends covered in brass headplates, with fire introduced on one side, water on the other. When this proved reasonably successful, larger ones followed.

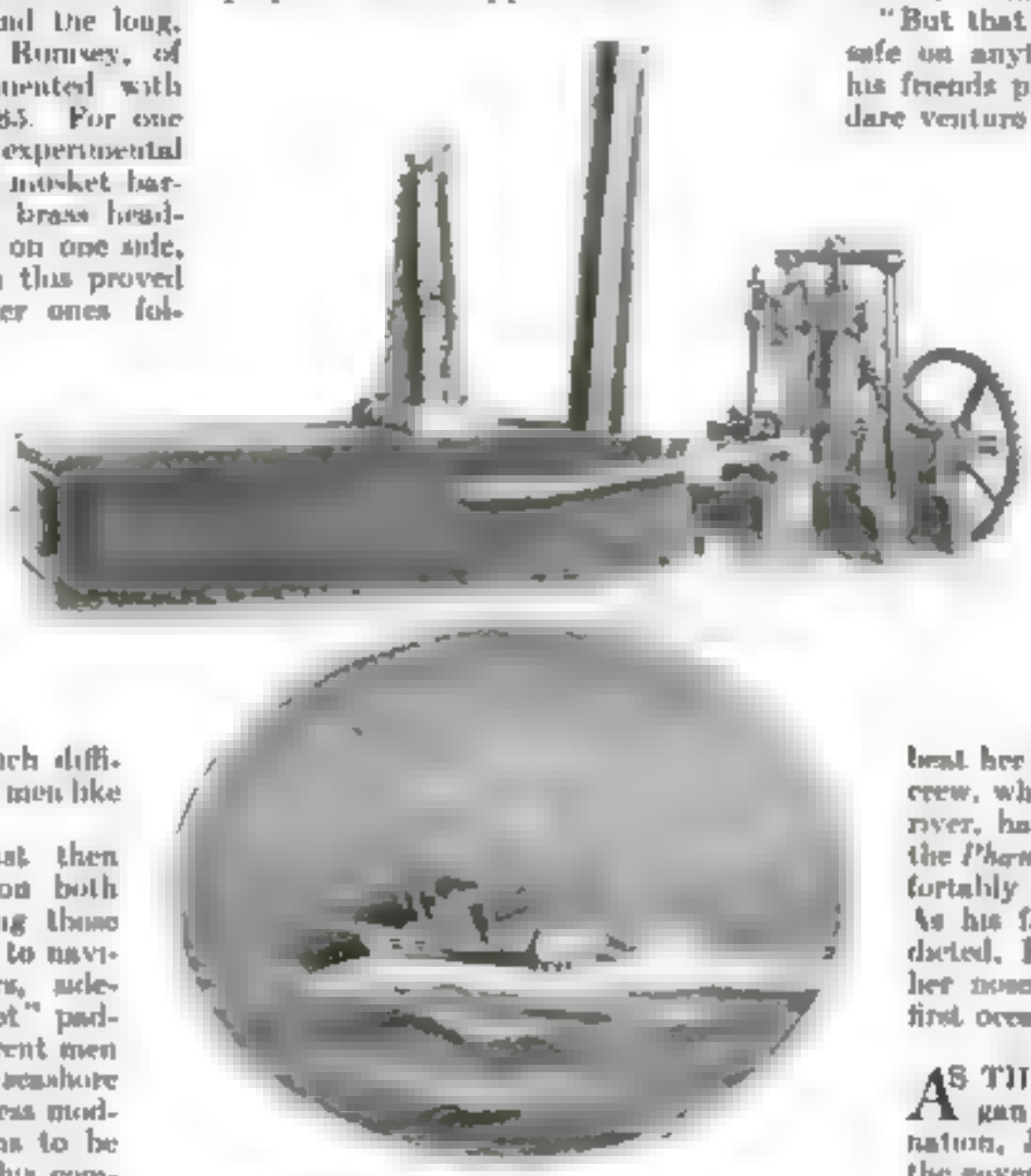
Mechanics were scarce in those days, and mostly second-rate in America. Tools were roughly made, chiefly as they were needed. What is called a "machine-fit," today, means what a micrometer gage says in thousandths of an inch. In 1800, the term meant "within the thickness of a worn shilling." But such difficulties as that could not stop men like John Stevens.

Steam engines were just then claiming much attention on both sides of the Atlantic among those who wanted to apply them to navigation. Steam-driven oars, side-wheels, and even "duck-foot" paddles had been tried by different men with varying success, and the seashore was fairly littered with useless models. It was left for Stevens to be half a century ahead of his competitors; for it was he who introduced the screw propeller.

His single screw came first. With this, built in a form amazingly like the one that is now so familiar, with an adjustable entering-angle, he got some speed but also, of course, bad steering effect. Then it came to him that he could use two screws, turning in opposite directions and supported on struts outside the hull of his boat, instead of through stern tubes like those built long afterward. By 1804 he completed and began running what was not only the first steamboat of importance on the Hudson river, but also the first twin-screw steamer known in the world.

SOME of his clever sons—he had half a dozen, though no others as brilliant as the two already named—acted as crew. Men, women, and children collected daily at New York's Battery, to watch her dash across to Hoboken and back. Dash is the right word, considering her date, because her engine drove her *eight* miles an hour, as was proved, forty years later, by an official committee of engineers. Whereas the boats that followed her a few years later, upon the Hudson, such, for example, as Robert Fulton's *Clermont*, claimed no more than five or six miles.

If anything like high-pressure steam had been known, in those early days, the propeller would doubtless have eclipsed every other design at once. But the four or five pounds a square inch, generally accepted as safe then, could not handle the propeller efficiently. Even some years later, when Colonel Stevens sent his son, John, Jr., to England, to consult James Watt, inventor of the modern condensing steam engine, and propose another type of boiler for the purpose, that elderly gentleman declared positively that high-pressure steam would always be a failure. It was left for Robert Stevens, later still, to be the man of all others who successfully demonstrated that Watt had set the safe limits of piston speeds much too low and to prove that the early ideas of speeds of ships were all wrong. Pending that time, the propeller starved for lack of steam, and John Stevens went back, for his larger boat, the *Phœnix*, to side-wheels such as Nicholas Roosevelt had been trying.



They Made Maritime History

Above, John Stevens' marine engine of 1804 now on exhibition at the Smithsonian Institution, Washington, D. C. The lower picture is a reproduction of an old painting showing Stevens' *Phœnix*, the first steamship that ever sailed the ocean

WHEN the *Phœnix* was completed, in 1808, Stevens found himself blocked by the grant of a Hudson river monopoly to Chancellor Livingston and his partner, Fulton. "Then I'll send her around to the Delaware," said Stevens.

"But that flimsy kettle will never be safe on anything but rivers or bays," his friends protested. "No man would dare venture down the coast with her."

"Yes, one man would," his son, Robert."

Just twenty-one at the time, Robert was quite ready to tackle the job some older heads thought foolhardy. As for that, his father had had him educated for just such work, and he was well equipped to clear New York harbor in the *Phœnix* with, oddly enough, a schooner sent along as stand-by and escort. When heavy winds came up, the schooner was forced out of her course and had to beat her stiff way back again. Her crew, when she finally drew into the river, had given up hope of seeing the *Phœnix*, but—there she lay, comfortably anchored, safe and sound. As his father had confidently predicted, Robert Stevens had poked her nose into history as the very first ocean-going steamer on record.

AS THE black cloud of 1812 began forming over our small nation, John Stevens suggested to the government that our war vessels should be equipped with engines. "Since," said he, "it appears inevitable that our ships will have to fight an enemy fleet, let us give them the incalculable advantage of choosing their own time to fight!"

He was striking, of course, the keynote of naval strategy and tactics since time began. Unfortunately, he found those in authority stone deaf. It was some years before his suggestion came into favor for punitive expeditions against the pirates of the West Indian seas. Failing in this effort, he moved—since he could never stand still—to another one.

Always with Robert as chief assistant, he made tests of cannon balls, fired into heavy oak targets and also against such targets after covering them with iron plates. Out of those experiments came two inventions of enormous importance. First, Robert developed the elongated shell, filled with explosive, more accurate and far more deadly in effect than the old round shot. This projectile was adopted by our government to become nothing less than the lineal ancestor of today's deafening fifteen-inch battleship salvoes.

Next, the tar- (continued on page 100)

WHEN you have finished Mr. Turnbull's absorbing account of the godfather of American invention, you will be eager to read his story, beginning next month, of the amazing man who was the father of American science and the world's first "popular scientist." Mr. Turnbull has presented a vivid picture of this many sided man in a four-part biography that supplies at once fascinating entertainment, useful information and an inspiring lesson.

THE EDITOR

Queer Pranks *MEMORY* Plays on Some Folks

Amnesia—What Causes It, What It Does, How You Can Prevent It—Strange Instances of Lost Identity

By Edwin Keithley

The man who suddenly vanished from a [illegible] possible amnesia victim. It is his escape from the drab realities of life that very often its victims are dreamers. The more practical person of any seldom fails victim to the mental disturbance which every year causes hundreds of men and women to drop suddenly from sight as if the earth had swallowed them.

ARE you a dreamer?

Do you find yourself staring continually far beyond the hard facts and responsibilities of the everyday grind—the bills, the family difficulties, a desk piled high with work, the maddening sameness of a drab existence? And does your tired mind seek relief by shutting out the details of the actual world about you and by conjuring up visions of a life so different that there seems no hope of bringing it about? Do you dream, perhaps, of the free life of the sea, or the lure of foreign lands?

If so—if you grow to hate what you are doing and become a painter of fantasies, in your heart shirking the responsibilities which outwardly you shoulder—then some day, before you are aware of it, there is a chance that your weary nervous system may choose an astonishing way of taking a rest. In an instant you may lose your identity. Your humdrum life, your family, your friends, your memories of the past—all may be blotted suddenly out of your mind as completely as if they never had been. And you may wander away, counted as dead by the world you have known, to take your place as a new person in new surroundings.

Months or even years later you may "come to." In a flash all the memories of the first life may return, and you may awake again to your old personality.

Such is amnesia, one of the strangest and most baffling, yet one of the most interesting of all mental pranks known to man. It is defined simply as "loss of memory." Yet so mysteriously does it come, and so old are its effects in many cases, that physicians have been at a loss to trace its causes or to prescribe definite remedies. They have found, however, that very often its victims are dreamers. The more practical person of any seldom fails victim to the mental disturbance which every year causes hundreds of men and women to drop suddenly from sight as if the earth had swallowed them.

The most common form of the ailment is known as hysterical or "dreamer's" amnesia, as distinguished from the serious form of epileptic amnesia, an organic disorder which sometimes results in criminal acts or suicide.

Young students quite often fall victims to hysterical amnesia, usually as the result of overstudy. One of the most recent cases, and one which attracted nationwide attention, was that of the 21-year-old son of a prominent government official. The young man, a freshman at Harvard University, apparently was entirely normal and in perfect health when he suddenly vanished from the campus at Cambridge. After nearly a week, in which the country was searched for him, he was found unconscious on the steps of a church at Rochester, N. Y. When taken to a hospital he was unable to recall his name or tell how he came to be in Rochester. Cards in his pocket established his identity, and his father and mother were summoned. As soon as he saw them his memory returned as suddenly and mysteriously as it had vanished. Yet all he was able to recall of his five days of wandering were two lights on the rear of an automobile! Subsequent tests showed that, aside from his temporary mental lapse, he was perfectly normal.

ALMOST equally baffling was the disappearance last winter of a young woman twenty years old a student of medicine in St. Louis. Starting for her classes one morning, she dropped completely from sight for forty-five days. The girl was found wandering in a dazed condition at the Union Station in Chicago. At the hospital where she was taken all efforts to learn her identity were in vain. There, hysterical from overstudy, she cried almost continuously for days, and she became known at the hospital as "the weeping co-ed." Since she spoke several languages, it was assumed she was a student.

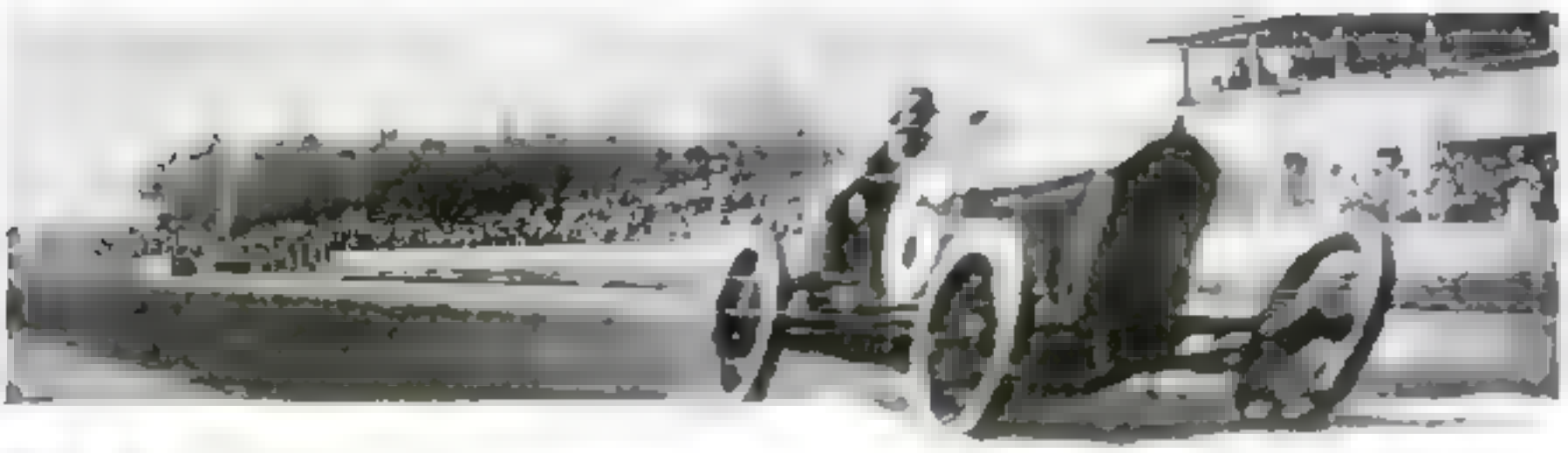
At last, despairing of ever learning who she really was, the young woman insisted upon going to work and was assigned to duty in the hospital. Then at her request, she was permitted to make a personal appeal over the radio. St. Louis newspapers repeated the event and published her picture, which was recognized by members of her family. When her relatives arrived at the hospital, the girl instantly recognized a coat worn by her aunt. Within a few moments her memory was restored completely.

THE unusual experience of this girl, physicians say, is a striking illustration of how the links of memory may snap when the tired mind seeks forgetfulness. Worn by overwork, she took every cent she had and went as far away from her unpleasant surroundings as her money would carry her.

A son of one of Europe's leading financiers regained his memory on the Bowery last March, after he had been missing for months. Soiled and unkempt, the youth strolled out of a cheap lodging house one cold Saturday afternoon looking for a job. Turning into the Salvation Army Mission near by to get warm, he (Continued on page 111)

A bank cashier suddenly left his desk and rifled the safe nonchalantly stuffing his pockets while other employees stared amazed. Such brain pranks often result from overtired nerves

Will Mosquito Cars Rule



Fleet Little Racers Astonish the World As They Vie with Monsters of Power —Aim at Speed of 200 Miles an Hour

JUST for the fun of it—on a level stretch of road, with clear sailing ahead—have you ever "stepped on 'er," and felt the thrill of speed? Have you watched numbers on the speedometer climb as the old bus leaps ahead under your touch and the roadside trees begin to swirl past in flying retreat? Thirty-five, forty, forty-five, forty-nine, fifty, fifty-one

The wheel in your hands becomes as sensitive as a trigger. Perhaps, if you have been accustomed to drive strictly within the speed limits, there creeps upon you a feeling of uncertainty that is almost sickening. What if a tire should blow, an axle snap? With a nervous chill you lift your foot from the accelerator, and as the car settles back to a comfortable pace you find yourself saying: "Gee, that was great—but thank the Lord it's over!"

You know how it is. Fifty-odd miles an hour, you'll agree, is plenty of speed for the nerves of most of us. But can you imagine driving *three times* as fast as that? Can you imagine aiming a motor car at some object ahead and shooting the car and yourself across a mile stretch in less than half a minute?

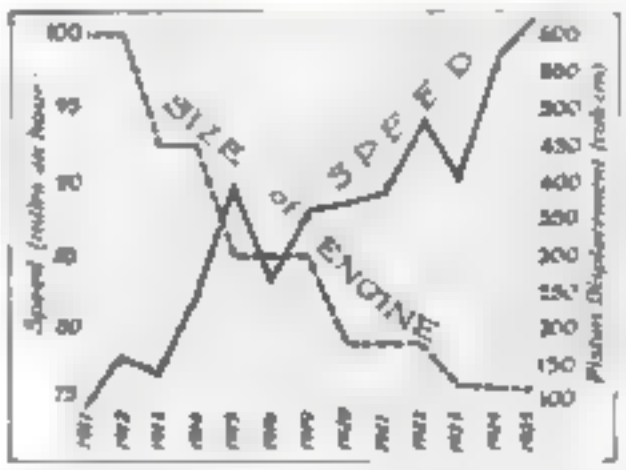
Of course you can't. Only a few men, as the records tell us, have done it, and these have been rather reserved champions of one of the most hair-raising sports in the world. Among them are Tommy Milton of American speedway fame who, some six years ago, shot his powerful Duesenberg over a mile of Daytona Beach at a speed a shade more than twenty-three seconds and J. G. Parry Thomas, who a few months ago claimed a record of 170.62 miles an hour after a speed test of a mile in Wales. Another of the royal line of speed kings is Major H. O. D. Segrave of the British Army.

A few months ago Major Segrave astonished the motor world when his miniature streamlined Sunbeam racer of flivver size set a record for the flying kilometer, leaping over a measured course along the beach at Southport, England, at the rate of 142.3 miles an hour.

With a flying start and a light wind at its back, the little Sunbeam tore across the firm sand, the roar of its twelve cylinders vying with the thunder of the surf. In a fraction more than fourteen seconds it had covered the kilometer distance (five-eighths of a mile) at the rate of a mile in about 23½ seconds.

If you could have witnessed this British pilot's performance, you might have gained a vivid idea of the skill and daring required to drive a car at such terrific speed. For on his return trip over the course, while Major Segrave was attempting a longer distance record, the little racer lunged into one of the most amazing antics ever seen on a track. Suddenly striking an unseen depression in the sand, the car jumped high into the air. With wheels spinning, it leaped for a distance of almost twenty yards before it came to earth again. Although the driver sat tight at the wheel and held his bucking charger under control, that one jump cost him his chance to hang up the longer record. For the racing of the engine as the wheels spun in the air put the supercharging mechanism out of commission and checked his speed.

The really significant feature of the Sunbeam's performance, however, is the fact that such speed was attained by a little machine with engine horsepower no greater than that of many of the lower priced pleasure cars which folks drive about the streets. Where the racing cars of Milton and Thomas were propelled by engines of enormous size and power, the Sunbeam's light engine developed only thirty-three horsepower. That the British racer was able to travel more than two and one-half miles a minute was due to the remarkable efficiency of every one of its moving parts. Here was another case of the little fellow's skill matching the big fellow's brawn. What the Sunbeam gave away in horsepower it made up in lighter weight, in the scientific con-



In 1913 a halt was called to the growing size of engines in the Indianapolis annual race. Since that time, while the limit on piston displacement has been set lower and lower, the average winning speed for the 500-mile classic, contrary to expectations, has steadily increased, as shown in the chart above

Courtesy "Automotive Industries"

The Fastest Thing on Land—170 Miles an Hour

—But the car in which J. G. Parry Thomas recently set a new record on the Welsh coast—Babs, shown above—has a 400-horsepower Liberty airplane engine, as compared with the 33-horsepower motor and 151-mile record of the flyweight Sunbeam, a picture of which appears on the next page

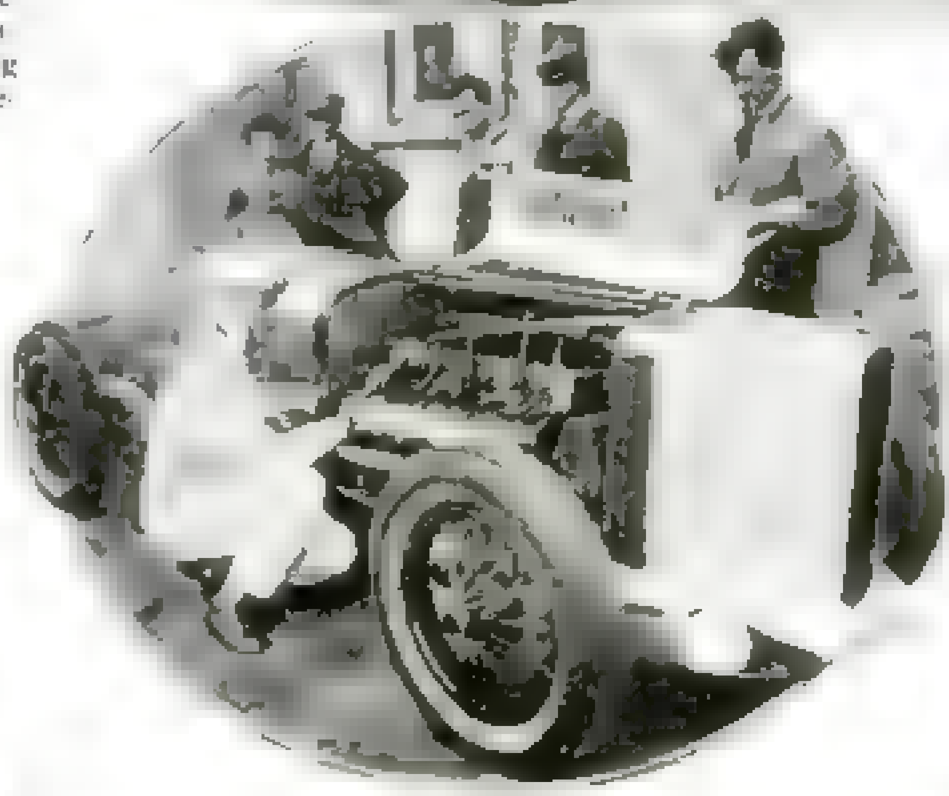
the Speedway?

By Edgar C. Wheeler

struction and adjustment of its machinery and in the studied design of its perfectly balanced streamlined body.

In this the Sunbeam is typical of a new tendency in the design of speed cars—a development which, in recent years, has taken automobile racing out of the realm of commercial display and has made it into a highly specialized scientific sport. It has become a sport of the keenest rivalry in which the deciding factors are ingenuity, pluck, mechanical skill and luck.

Time was, in the earlier days of racing, when nearly every automobile was a potential racing car, and when sixty miles an hour was considered amazing. More speed was the goal of the automobile manufacturer, for speed, rather than riding comfort, then was the basis on which the success of his product was judged. As a result, the speedway became the commercial display ground for competing car makers, who sent out their "stock cars" to hang up new records.



The Baby Car That Rivals the Giants

[illegible]

THE outcome of such competition, naturally, was that the manufacturers began to put an extra "kick" into the "stock models" that were used on the tracks, installing larger and more powerful engines, until the racing car became a roaring monster.

At last a halt was called to the growing size of engines and cars. For machines entering the Indianapolis speedway classic a limit was set on piston displacement. And to the surprise of almost everyone this limit, instead of reducing the speed of the racers, increased it! In 1911, when the maximum piston displacement was set at 600 cubic inches, the winning speed at Indianapolis was 74.59 miles an hour. In 1913, when the limit was reduced to 450 cubic inches, the speed jumped to 76.92 miles an hour. In the following years came successive reductions in the displacement limit, to 300 cubic inches, then to 183, then to 122. And each reduction in size brought a new 500-mile world's record, the last of which was set by Peter DePaolo last year with an average speed of 101.13 miles an hour.

This year the displacement was cut once more to 91½ cubic inches. Whether the latest of the small cars will surpass their predecessors remains to be determined, for this year's race at Indianapolis was marred by a downpour of rain and a slippery track.

Yet despite the perilous going Frank Lockhart, a young daredevil from Los Angeles, thrilled 150,000 spectators by driving his little white racer 400 miles at an average of more than 94 miles an hour. At one point he was running above 100-mile speed.

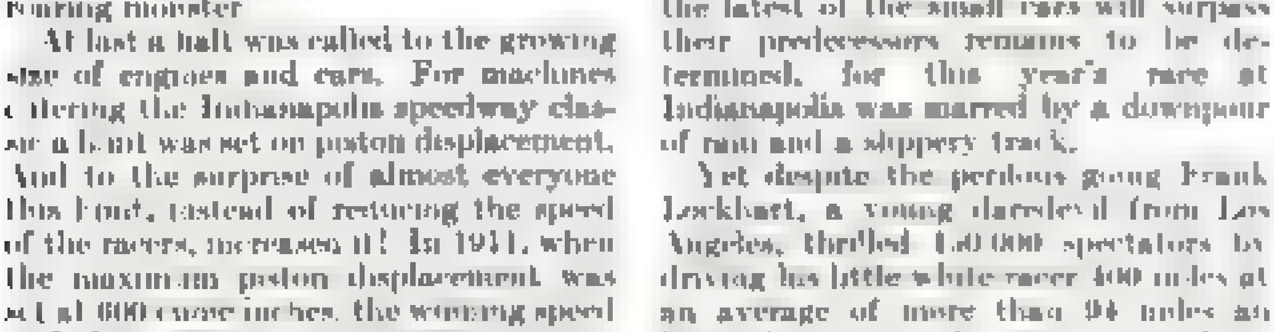
Lockhart's car is typical of the new idea in racers. It is driven by a compact eight-cylinder engine with a piston displacement of only 90.2 cubic inches. Instead of using as many as four valves for a cylinder as was common practice in racers of only two or three years ago, this

[illegible] nearing completion at [illegible] mile-an-hour record. It will be the largest car the world has ever seen, with two engines of 500 horsepower each, making a total of 1000 horsepower! Oddly enough, this monster, named "Hush-Hush II," is of the same make and will have the same pilot as the midget Sunbeam which showed such a burst of speed at Southport. When the new record is attempted, probably in September, Major Segrave hopes to reach a speed of more than 200 miles an hour!

Often the outcome of a race hangs by a thread. In the recent Indianapolis race, for example, the very hazards of the rain-washed track called for every ounce of the drivers' resourcefulness. The failure of a single part in one of the smooth-running power plants was enough to force it out of the contest. Such a failure at the end of fifteen miles blasted the hopes of Alfred Guyot, the noted French driver. A broken connecting rod ended the running of a superb car of which big things had been expected.

Just one small act of fate—a dash of rain on the goggles of one of the drivers—caused a machine to crash into a wall at one of the turns.

A SLIGHT delay at Culver City, Colo., last November was all that prevented Earl Cooper from hanging the 250-mile world's record to his belt after he already had smashed the records for 75, 100, 150 and 200 miles. Speeding at 130 miles an hour, he was leading the field until he ran out of gas, just when the biggest prize was within his grasp. He finished fifth, while the 250-mile record was captured by Frank Elliott at an average of 127.87 miles an hour.



Every Line Designed for Greater Speed

The new trend in racing car design—low center of gravity and close attention to streamlining—is shown in this car, the Eldridge Special, entered at the Indianapolis sweepstakes. The engine and differential are out of center, sinking the driver's seat to a new depth, thus lowering the center of gravity

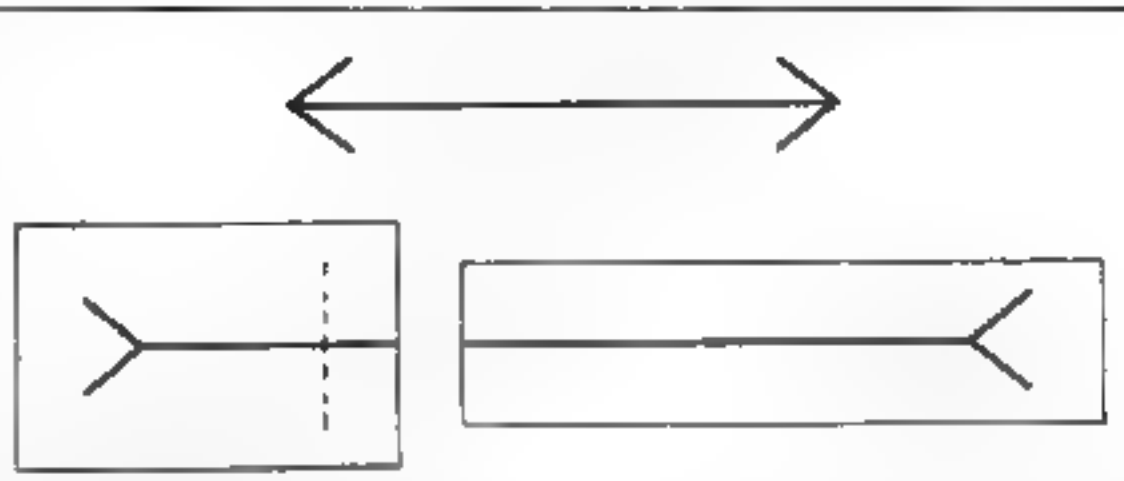
Try These Tests

And Get the Measure of Your Abilities

A Test of Your Memory

LET someone read each of the following groups of numbers to you at the rate of one number a second. After each group is read, repeat the numbers in the reverse order. Suppose, for example, the numbers 1, 2, 3 are read. Your answer would be 3, 2, 1. See how many of the groups you can repeat correctly, then turn to page 119 for your rating.

4 7
7 9
8 2 5
4 6 1
3 6 8 2
4 9 8 7
1 4 6 8 5
2 9 6 7 3
4 7 1 9 5 2
8 3 6 2 5 7
3 2 9 4 8 5 1
9 4 5 3 8 3 7
4 1 6 2 5 9 3 8
2 7 5 4 9 8 1 6



Are You a Good Judge of Distances?

HAVE you ever tried to guess at a certain measurement? It's surprising how your eyes can deceive you. Here is a fascinating test of your accuracy in judging distances. First cut out the two lower figures, then cut a slit along the dotted line in the left-hand figure and insert the right-hand figure so that the black horizontal line will be continuous. Now slide the pieces back and forth until, in your judgment, the length of the horizontal line equals that of the top figure. Then measure to see how nearly you were right.

This test, with the others on this page, was prepared by Dr. A. M. Johanson of the Department of Psychology, Columbia University. They are one of a fascinating series appearing from month to month in POPULAR SCIENCE MONTHLY at the request of many of our readers.

Do You Keep Well Informed?

EACH of the following sentences holds a statement of some widely known fact. Underscore in each sentence the one of the four concluding words that makes the truest statement, allowing yourself seven minutes to complete the test. When you have finished, turn to page 119 for the correct answers and your rating.

1. Combustible things will rip fight burn break.
2. A baby always has eyes laugh [illegible]
3. Maroon is a kind of fabric food drink color.
4. Rubber is obtained from ore sand trees hides.
5. A citizen has city privileges male [illegible]
6. Indigo is a food drink color fabric.
7. A dungeon always has prisoner chains crime gloom.
8. Independence Hall is in Washington Boston Richmond Philadelphia.
9. Emerald is red blue green purple.
10. A candle always has a stick smoke wick flame.
11. The American commander in France was Wood Baker Pershing Sims.
12. Ivory is obtained from oysters mines elephants reefs.
13. Alfalfa is a kind of hay corn drink rice.
14. The King is used in croquet tennis golf checkers.
15. Satin comes from a kind of beetle plant sheep worm.
16. Electric bulbs were invented by Marconi Edison Morse Volta.
17. Influenza is a disease of the heart kidneys nerves lungs.
18. Diamonds are obtained from reefs mines crocodiles meteors.
19. It is usually coldest at sunrise sunset noon midnight.
20. The heaviest metal is iron lead gold aluminum.
21. Vermouth is the name of a cloth dance drink food.
22. Ty Cobb is a golfer aviator prizefighter baseball player.
23. Yoga is a kind of germ plant savage religion.
24. The tractor is used in gardening fishing farming racing.
25. The differential is a part of an automobile watch wagon pistol.
26. "Kenilworth" was written by Wells Scott Service Kipling.
27. The holstein is a kind of fish fowl cattle horse.
28. Rivets are usually put in shoes hats harness houses.
29. The League of Nations was written in Washington Paris London The Hague.
30. Cheviot is the name of a cloth dance drink food.
31. The most expensive metal is gold silver platinum radium.
32. Turpentine is obtained from rocks rivers mines trees.
33. The esophagus is in the head neck abdomen stomach.
34. An arrow always has a bow hunter quiver shaft.
35. A six-sided figure is a scolium pentagon hexagon trapezium.

How Clearly Do You Think?

TO FIND out how logically your mind works—that is, how readily you reach the correct conclusion from certain given premises—underline the correct word in each of the following conclusions, allowing yourself ten minutes to complete the entire test. See page 119 for your rating.

Example: If A is richer than B, and B is richer than C, then

B is richer, poorer than A
C is richer, poorer than A

1. If Mary swims faster than John, and John swims faster than Sue, and Kate swims slower than Sue, and Ned swims slower than Kate, then

Mary swims slower, faster, as fast as, than Kate.
Sue swims slower, faster, as fast as, than Mary.
Ned swims slower, faster, as fast as, than Mary.
Sue swims slower, faster, as fast as, than Ned.

2. If brass is weaker than copper and steel is stronger than copper, and brass is stronger than lead, and copper is as strong as bronze, then

Steel is as strong as, weaker, stronger than lead.
Bronze is as strong as, weaker, stronger than steel.
Copper is as strong as, weaker, stronger than lead.
Brass is as strong as, weaker, stronger than lead.

3. If George is older than Henry, and Tom is older than Fred, and Henry is as old as William, and Tom is younger than William, and Arthur is younger than Fred, then

Fred is as young as, older, younger, than William.
George is as young as, older, younger, than Tom.
Arthur is as young as, older, younger, than William.
Henry is as young as, older, younger than Arthur.

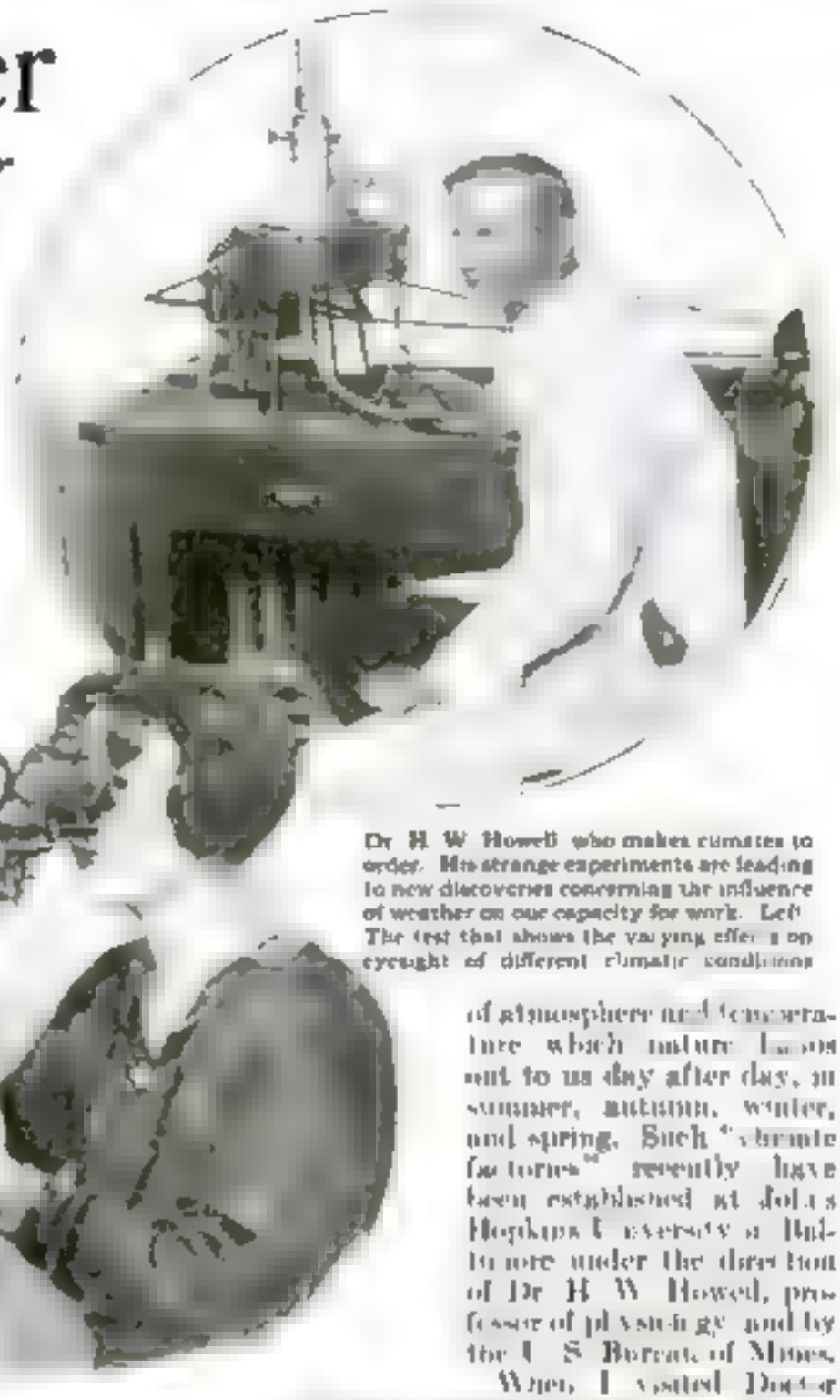
4. If an orange is sweeter than a grapefruit, a pineapple is sweeter than an apple, a tangerine is as sweet as an orange, a grapefruit is sweeter than a pear, a tangerine is less sweet than an apple, then

Pineapple is as sweet as, sweeter, less sweet than tangerine.
Apple is as sweet as, sweeter, less sweet than grapefruit.
Pear is as sweet as, sweeter, less sweet than tangerine.
Orange is as sweet as, sweeter, less sweet than pineapple.
Apple is as sweet as, sweeter, less sweet than pear.

Don't Pity the Fat Man in Hot Weather

He Suffers Less Than Other Folks—Strange New Facts about Heat and Your Work

This amazing "climate factory" at Johns Hopkins University manufactures any degree of temperature and humidity by passing air through heating and cooling coils, fans and water sprays. It can change the weather in a few minutes from shivering January to sizzling July



Dr H W Howell who makes climates to order. His strange experiments are leading to new discoveries concerning the influence of weather on our capacity for work. Left: The test that shows the varying effects on eyesight of different climatic conditions

If you can't work in summer as you do at other seasons don't blame yourself too much. Prolonged bodily and mental effort is humanly impossible in extreme heat. This and other interesting facts have been proved by these truly remarkable tests

By NORMAN C. McLOUD

IT'S a sweltering day in midsummer. The burning sun beats down on sizzling roofs and pavements. Lifeless, muggy air seems to close in upon you like an oppressive wall as you try to go through the day's work.

Somehow your job has lost its thrill. Tasks that ordinarily command your interest and challenge your wits have become push drudgery. Your hands lag, your shoulders droop listlessly. You wipe the perspiration and dig away.

"It's not the heat," you say. "It's the humidity. I could stand the heat if it wasn't for this muggy air. It takes all the life out of a man."

Always, when the dog days of summer come, you hear people express their discomfort in much these same words, holding "the humidity" to blame for wilted collars, frayed nerves, mean dispositions and other hot weather woes.

This summer, however, we'll have to revise many of our notions about what makes us wilt. For scientists, by remarkable laboratory experiments, are discovering important new facts concerning the relation of intense heat and humidity to our bodily comfort and our working efficiency. Now they tell us, we must change the time worn phrase, "It's not only the heat; it's the humidity," to read "It's not only the humidity. It's our pulses."

In the past the commonly accepted explanation of discomfort on hot muggy days has been that humid air—that is, air saturated with moisture—raises the temperature of our bodies by preventing the cooling evaporation of moisture from the skin. The latest experiments, however, seem to show that the extent of our discomfort depends not so much on the rise in body temperature as on the increased speed with which our hearts beat. They have led to other discoveries, too, concerning the influence of hot weather on the endurance of our muscles, nerves and senses—discoveries which promise future benefits in promoting the efficiency of workers and determining the effect of weather on bodily resistance to disease.

This new knowledge is being brought to us largely through the perfection of remarkable mechanical apparatus with which it is now possible to manufacture all kinds of climate to order in the scientist's laboratory, in other words, to reproduce artificially the varying changes of atmosphere and temperature which nature hands out to us day after day, in summer, autumn, winter, and spring. Such "climate factories" recently have been established at Johns Hopkins University, Baltimore, under the direction of Dr H W Howell, professor of physiology, and by the U S Bureau of Mines.

When I visited Doctor Howell in his laboratory the other day I could almost imagine myself in some enchanted room of a magician. For merely by touching a number of buttons, this unusual scientist changes the seasons at will. Within a few minutes he turns freezing winter into boiling summer, or a longest June day into the cold damp of late autumn. And in the sealed chamber where these transformations take place he has set up strange mechanical devices with which he measures the effects of his homemade climates on the bodies and minds of his subjects. With these devices he is studying the relation of climate to mental and muscular fatigue, to our skill in workmanship, to the alertness of our senses, and to our health.

IN THE morning Dr Howell figures out a schedule of weather he desires for the day. It may suggest this out line:

9 a m to 12 noon: Temperature, 95 degrees in the shade, relative humidity, 100 percent. Net result, an atmosphere as oppressive and nerve racking as the worst day in August.

1 to 3 p m: Temperature, 83 degrees; relative humidity, 25 percent. Net result, an atmosphere clear and bracing, like a fine day in January.

3 to 5 p.m.: Temperature, 85 degrees; relative humidity, 25 percent. Net result: an

atmosphere of June, when it is good to be alive, and easy to work or play.

"That ought to be enough variety for today," he may say, handing the list to an assistant. "Now you can start the plant. We are ready for midsummer."

The assistant manipulates certain buttons and levers, and immediately the wheels of the factory begin to turn out climate to order. The plant itself consists of an arrangement of heating and cooling coils, fans, and water sprays into which air from outdoors is drawn through a system of ducts and channels. It can be controlled to heat the air to any desired temperature, and at the same time supply the required percentage of relative humidity, ranging from the point of saturation to the low ratio found in atmosphere that is clear and bracing.

THE first item on the day's bill might call for the reeking heat of 95 in the shade, with 100 percent humidity. To produce this condition, the air from outdoors is put through a process of piling up additional moisture. Starting at a temperature, say, of 53 degrees and relative humidity of 43 percent, it encounters a water spray of high temperature. The increased temperature immediately raises the capacity of the air for absorbing moisture, while the spray supplies the moisture. Saturated with all the moisture it can hold at a temperature of 95 degrees, the humid air is carried through channels to the test chamber—a room made air-tight except for a carefully controlled ventilating apparatus which regulates the purity of the air without changing its character.

HERE, in the oppressive, muggy heat, the operator now tests a human subject with a simple apparatus for measuring muscular energy and fatigue. The subject is seated at a table, his right arm placed in a fixed groove that limits the muscular movement of his arm to backward and forward motion. To an attachment on his forefinger is fastened a wire supporting a heavy weight swung from a pulley at the end of the table. As the subject pulls the weight, the movement of his arm is registered by an automatic pencil on a chart affixed to a revolving drum. Every pull is recorded by a line, the length of which tells the vigor of the pull. Thus, as the muscles grow tired, the lines become shorter until, when the subject can no longer lift the weight, they vanish.

On the chart the scientist reads a graphic story of increasing fatigue that follows continued muscular exertion. The tests demonstrate, for example, that high temperature and humidity cause a marked decrease in energy. Such slight effort as that involved in holding the arm extended from the body adds further evidence. At a temperature of 95 degrees and relative humidity of 100 percent, the subject's ability to maintain this position is lowered virtually one half, as compared with his ability in comfortable atmosphere, such as 70 degrees with 50 percent relative humidity.

Another testing apparatus reveals the influence of the weather on the steadiness of a man's muscles and the response of his nerves, recording variations in muscular

Testing the Weather's Effect

effect on the muscles and nerves

control in work involving fineness of touch. In still other tests, mental efficiency is measured by giving the subject complicated tasks, such as problems in mathematics. The results thus far promise useful knowledge of the influence of climate on the efficiency of brain workers. The relation of continued exertion to eyesight also is studied by means of an instrument called a "phorometer," which records ability to sustain clearness of vision while working under trying conditions of heat and humidity.

Dr. Howell's experiments also have much in common with tests by the Bureau of Mines, demonstrating that hot weather discomfort and fatigue bear a definite relation to the rate of pulse beat. It has been found, for example, that when the pulse rate is increased by high temperature and humidity from the normal of 72 to 135 beats to the minute, real bodily distress results, while at the rate of 160 beats the condition becomes unbearable.

Some time ago a group of young men offered themselves as subjects for tests in the "climate factory" of the Bureau of Mines. As they entered the inclosed chamber where varying extremes of weather are reproduced, they laughed and joked among themselves.

But once they were inside and the thermometer shot up to 95, then 100 degrees, the experience became anything but a lark. After two or three minutes at 95 and 96 in the shade, every one of the men became restless and irritable. Their hearts began to hammer at their ribs, and they complained of throbbing headaches and intense thirst. Their eyes became inflamed, and they experienced a feeling, they said, as if weights had been placed on their chests. At last it became an effort even for them to speak.

ALL the time their increasing discomfort was attended by rapidly increasing pulse rate. At a temperature of 95 degrees, with full, humid air, their pulses jumped from the normal to anywhere from 134 to 158. The slightest effort made them pant for breath. At 100 degrees their pulse rate reached 178 to 180, beyond the limit of endurance. For an hour after leaving the chamber they were weak and lifeless, suffering acutely from the "dragged out" feeling that most of us have experienced on hottest summer days.

THESE tests also shattered a number of popular beliefs about hot weather. For one thing, the common belief that there is danger of cramps from drinking ice water while you are exposed to high temperatures was found to be groundless. Two of the subjects consumed a quart of ice water within a period of fifteen minutes without suffering ill effects. It was revealed further that the world has wasted a lot of sympathy on fat people, who always are supposed to be the greatest sufferers in hot weather. It was found that stout subjects could stand the heat much longer than thin ones. The stout men grumbled less, too, and complained less of exhaustion. While they lost more weight than their thin comrades, they had more to lose. And what they lost was regained quickly.

Altogether, the results gained from these experiments have shown scientists many possibilities for useful application.

He Caught *the* World *by the* Ear

How Emile Berliner, a Clerk, Made World's First Microphone from a Child's Drum

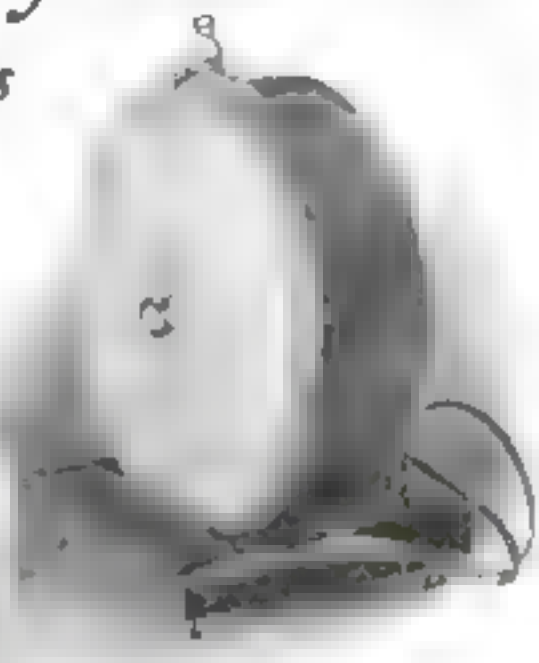
By Nell Ray Clarke

Earliest Disk Record

A comparison of the first crude talking machines gave Berliner the idea of the modern disk record. The result was the gramophone above, a device first demonstrated in 1888

Berliner, in the Room of His First Invention

In this bare room forty-eight years ago, Emile Berliner invented the mouthpiece that perfected the telephone and became our radio microphone. It was the first of the achievements which placed him, with no scientific training other than his own study, among leading inventors



From a Little Toy Drum

A radio microphone is merely a telephone transmitter enlarged for broadcasting purposes. Made out of a toy drum, Berliner's original telephone mouthpiece, above, looks for all the world like the "mystic black box" used by broadcasters now

NO ONE man in the world is responsible for our hearing more words to the minute every day of our lives than Emile Berliner. He gave us the mouthpiece in the telephone, which has also become the most important mouthpiece on earth — the microphone, used universally in radio broadcasting. Berliner also originated the modern disk talking machine and the idea of duplicating its records.

Literally he has the world by the ear. We are a talked-to as well as a talked-about country today because of Berliner's achievements.

In addition, he helped to chase the germs out of milk bottles and invented the machine which up to the present time permits the most successful attempts at vertical flight. His helicopter, developed during the last four years by his son, Henry A. Berliner, is a mechanical contrivance which can fly vertically from the ground and then, by flipping its tail, change into horizontal motion. And he has just completed the invention of an acoustic tile which has the resonant qualities of wood, but lends the dignity of stone to church and auditorium interiors. By way of relaxation he composes music, writes poems, and paints portraits in oils.

Three quarters of a century have gone over his head, but Berliner is not resting on his laurels. Every day he is at work from early morning until dusk, and he is brim full of ideas of what he wants to do next. His eyes are keen—he takes off his glasses to read, and he hasn't changed their lenses in twenty-five years. Some one recently asked him how he got his complexion, and he whimsically answered that he sandpapered his face every morning after shaving.

Like Michael Pupin and Alexander Graham Bell, Emile Berliner came to America as an immigrant. He was born in Hanover, Germany, in 1851, of humble parentage, but he inherited a love of music from his mother. He had only a common-school education, and came to this country when he was eighteen.

Strange as it may seem, the only possession which he brought with him as an immigrant—his love of music—was responsible for all his most important scientific inventions. He walks about his laboratory armed with a tuning fork. His secretary calls it his talisman, but he calls it his steel wishbone, for when he has some particularly difficult problem to solve, he strikes the "wishbone" and has the answer, just like the princess in the fairy story.

HE DOES not know why he gravitated to the field of science, he told me that, without any scientific training, he had always been interested in the accomplishments of scientists. He took a job as clerk in a store when he first arrived in Washington, and then for a while he tried everything, from selling glue to painting backgrounds on enlarged photographs. In his spare time, however, he used to poke about the only electrical shop in Washington, kept by George C. Maynard, who later became chief of the scientific department of the National Museum. Maynard's store in those early days, filled with a few telegraph keys and sounders, some lime-stone batteries, and one or two kinds of induction coils, fascinated Berliner more than any form of amusement. Alexander Graham Bell gave the world the great principle of the undulatory current and the earpiece of the modern telephone. Berliner gave it the mouthpiece—a transmitter operating by battery current—and the application of the induction coil, which boosts that current.

"I HAD read about the Bell telephone during 1876," Mr. Berliner told me, "and though I had never seen it I was much interested in it. I got some electric wires and other things from Mr. Maynard's store and went to work to make a telephone myself. There was no such thing as commercial electric light in those days, and the knowledge anybody had about the possibilities of electricity was slight. At that time, in a large room in the Capitol near the dome upstairs, there was a big battery consisting of about one hundred Bunsen cells. Every Fourth of July the papers announced that the electric light would be shown from the Capitol, and everybody went down on Pennsylvania avenue. All at once we would see a brilliant arc light at the lower part of the dome. Then it went out because the battery polarized, and we had to wait about half an hour for another glimpse of it.

(Continued on page 122)

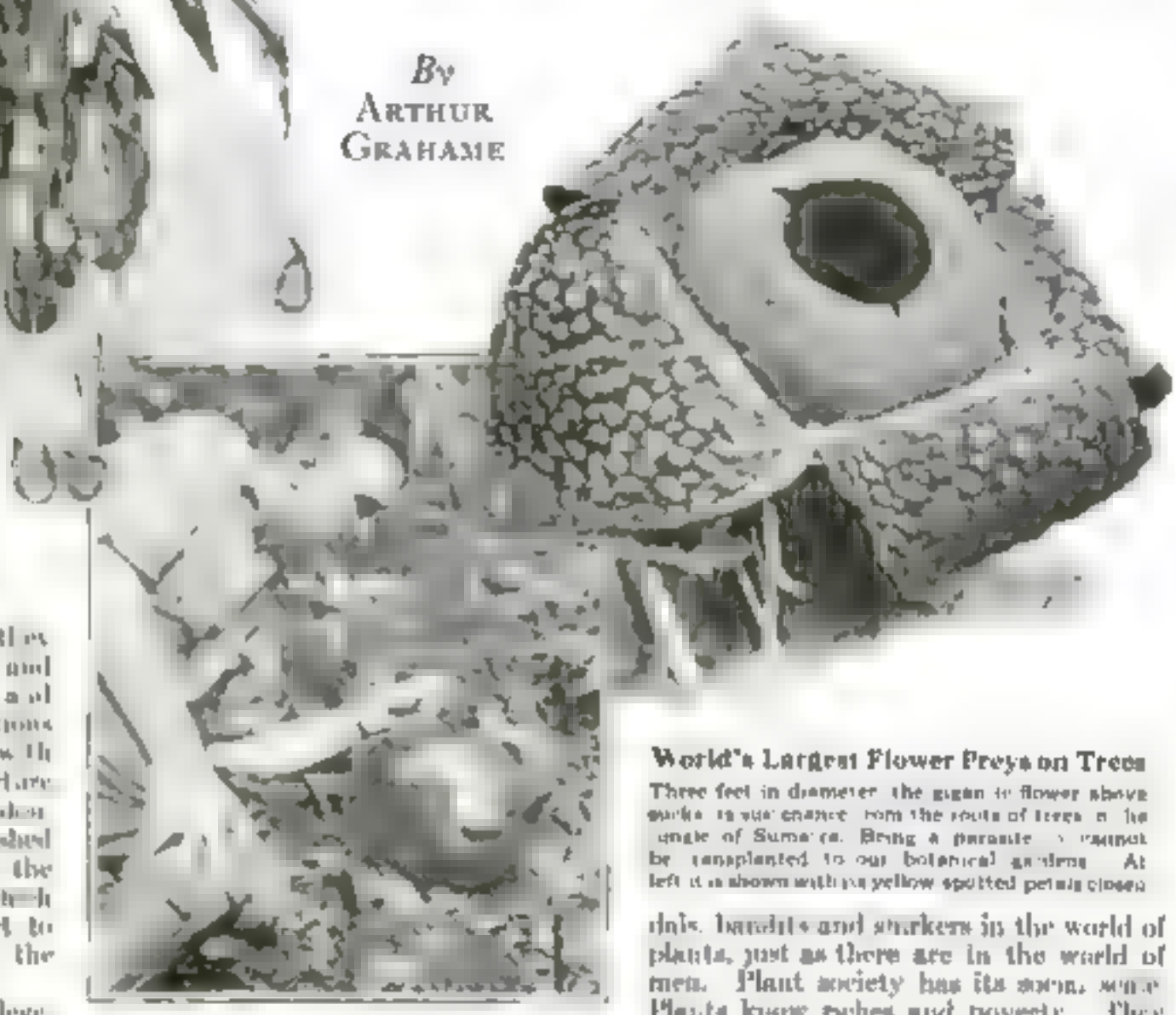
Plants That Almost *THINK*

They Steal Food, Attack, Defend, Have All Senses Except Hearing —Strange Stories of Man-Eating Trees and Vegetable Criminals

By Arthur Grahame

Each Blossom a Water Pitcher

The strange tropical plant above has solved the problem of living in climates where human throats parch. Its pitcher shaped flowers catch and hoard every possible drop of the rainfall



World's Largest Flower Preys on Trees

Three feet in diameter, the gigantic flower above sucks its sustenance from the roots of trees in the jungle of Sumatra. Being a parasite, it cannot be transplanted to our botanical gardens. At left it is shown with its yellow spotted petals closed

HAVE plants feelings? Do they think? Have they, like men and animals, sensitive brains and nervous systems? These are questions that scientists have been discussing with renewed interest since, in a recent lecture delivered at University College, London, Sir Jagadis Chandra Bose, a distinguished Indian plant psychologist, revealed the results of astonishing experiments in which he found, he said, that plants react to pain, poisons and danger in much the same manner that man reacts.

In his laboratory at Presidency College, Calcutta, Sir Jagadis declared, a delicate electrical apparatus known as a "resonant recorder" revealed amazing facts about the crowded world of vegetation. A carrot winced at pain! When he touched a sensitive plant with fire, not only did the leaves shrink away and fold up, but the branch bearing them swooped sharply to escape the flame. Many plants, he found, believe in a ten-hour day, for they sleep all night, and, like many humans, doze from six to nine in the morning. Other plants seldom sleep. He was able, he said, to produce an artificial paralysis of a plant nerve, and then cure it with a treatment found to be effective in the removal of paralysis in animals. Thin plants, he found, are more excitable than stout plants, and plants grown under glass, while they look healthy, really are flabby.

While American scientists have been keenly interested in Sir Jagadis' discoveries, they do not all agree with his conclusions. Dr. William Crocker, head of the Boyce Thompson Institute for Plant Research, is one authority who is skeptical.

"I do not think that his theory about plants having nervous systems is safe," he says. "Nor do I believe that plants grown under glass are in a state of lethargy. Plants under glass are less responsive, perhaps, than flowers grown out of doors, because the glass cuts off much of the ultra-violet rays of the sunlight.

Some other American scientists hint that their Indian colleague has been mixing Hindoo mysticism with modern science. Nearly all agree, however, that research seems to show a striking likeness between plant reaction and human reaction.

EXCEPT that plants are by their nature stationary, rooted to the ground and hence unable to wander about in search of food and comforts, they match in almost every particular the life processes, habits and activities of man and the other animals. Plants are born into the world as the result of a union between two previous individuals of their species. They marry and raise families quite as man does. They grow hungry and thirsty, and they satisfy their appetites with food and water, digesting and assimilating food products as the animals do. They have respiratory organs with which they breathe.

Their economic life, too, is almost as well defined as that of the animals. They barter and exchange, exercising when necessary a talent for business that is quite amazing. There are thieves, vandals, bandits and sharkers in the world of plants, just as there are in the world of men. Plant society has its scum, some. Plants know riches and poverty. They adapt themselves to their environment, clothing themselves against the cold, ingeniously manufacturing their food where Nature fails to supply it, changing their structure or the color of their flowers to suit the necessities of their surroundings. Evidence that plants possess intelligence of a sort is to be observed everywhere. Apparently, scientists say, they possess all the senses except hearing. They use weapons to defend themselves against attack. In short, just like man and the animals, they come into the world and fulfil their natural destiny, living, rejoicing and suffering, are at last dying and leaving behind descendants to continue their line.

NOT long ago Dr. George W. Cale, an American neurologist and surgeon, electrized the plant known as the Venus fly trap. He found that it became insensitive, and could not be brought into a state of activity even when tempted with insects, supposedly its natural prey.

Professor Haberlandt, a German scientist, says that plants have eyes—transparent cells in the skin of their leaves—and that these eyes not only enable them to distinguish between darkness and light, but also make it possible for each leaf to take up its proper position in rela-

tion to other leaves, so that it will get its fair share of sunlight. Professor Harold Wager, an English man of science, is said to have proved the truth of Haberlandt's contention that plants have eyes by substituting for a camera lens a spider wart leaf, and taking photographs'

CONCLUSIVE proof of actual intelligence in plants, however, is extremely difficult. Even in the animal kingdom, science so far has been unable to tell us just where on the scale intelligence starts. Animal life so small that it can be seen only with the aid of a microscope shows distress and attempts to escape when brought into contact with acids. Plants show somewhat the same reaction. Will the scientists of the future prove to us that all life, in its fundamentals, is the same?

More than a quarter of a million plants have been classified. Everywhere they are engaged in an endless and merciless struggle for existence. There is more vegetable life than the earth can support, and the law of nature is that the weak and the unfortunate must die. But plants do not die without a struggle for life. Although most scientists say that they have no brains, they will employ ingenious methods to obtain the sunlight, air, moisture and mineral foods that they need to live and grow. Some trees send out long roots to get water. Others develop large leaves in their efforts to capture sunlight. In South America there grows a plant whose leaves are slit so that some of the sunlight will penetrate to the leaves close to its trunk. Sunflowers turn their faces always to the sun; other plants, in hot climates, turn the edges of their leaves, rather than their faces, toward the sun, so as to avoid too intense heat

Probably it is the marvelous instinct or intelligence displayed by plants in their struggle for life that is responsible for the most remarkable story we have heard regarding the wonders of the vegetable kingdom.

A MAN-EATING tree! Such was the monster of the vegetable kingdom described some years ago by Carle Liche, a traveler in Madagascar, in a letter to Dr Otnelius Frostoskia—a letter which attracted world wide attention. Liche's account was dramatic. Traveling in the remote interior of the island with a party of savage natives of the Mkodo tribe he had seen the tree himself—a pineapple-shaped vegetable eight feet high, and thick in proportion with hanging leaves twelve feet long and armed with terrible thorny spikes. Horror-struck, he had seen an unfortunate native driven by the spears of his fellow-tribesmen into the deadly embrace of those closing leaves as a human sacrifice to the worshipped devil tree. He had seen him crushed slowly to death. Passing that way a few weeks later he had seen the leaves unfolded again and under them a few bones. The tree had devoured its victim, and was lying in wait for another.

Later Dr Chase Salmon Osborn, ex-governor of Michigan, veteran traveler, and the only American member of the Madagascar Academy of Science, visited Madagascar. When he did not see the man eating tree, he heard much about it from the natives of various tribes—so much that he decided that Liche's weird story must have been built on a foundation of solid fact.

From Central America comes another story of a man-eating tree. An explorer, returning from Nicaragua, reported in a lecture that he had seen a tree whose tentacles sucked the blood from any animal unfortunate enough to come into contact with them, that his dog had become enmeshed in the foliage of this carnivorous vegetable, and that in trying to rescue the animal, he—the explorer—had fallen into the grip of the hungry tentacles, and had escaped with his life only at the cost of the loss of portions of flesh from his hands and legs.

"Bunk!" you may exclaim. But is it all "bunk"? Darwin believed that certain plants live on insects that they capture. His monograph, "Insectivorous Plants," was scientifically famed in its time—and botanists of today are familiar with several plants which are at least insect-capturing, if not insect-devouring.

THE best-known varieties of insect-capturing plants are the pitcher plant and the Venus fly trap. The pitcher plant has leaves shaped like pitchers, the tops of the pitchers being delicately-balanced lids. The bottom of each pitcher holds a colorless fluid with an odor attractive to insects, and the inner walls are covered with fine hairs, normally pointing downward. An insect pushes open the lid and enters. When it tries to depart it finds the lid closed and the hairs bristling. It struggles against its fate until it falls exhausted into the fluid at the bottom of the pitcher and is drowned.

The Venus fly-trap, a beautiful plant with delicate, fragile flowers at the ends of slender stems, is as deadly. Each of its leaves is equipped with teeth, and with three sensitive hairs. When one of these hairs is disturbed by contact with an insect's body, the leaf folds together its teeth interlocking. Then surface glands give off a sticky fluid, and the insect is held prisoner until death ends its struggles to escape.

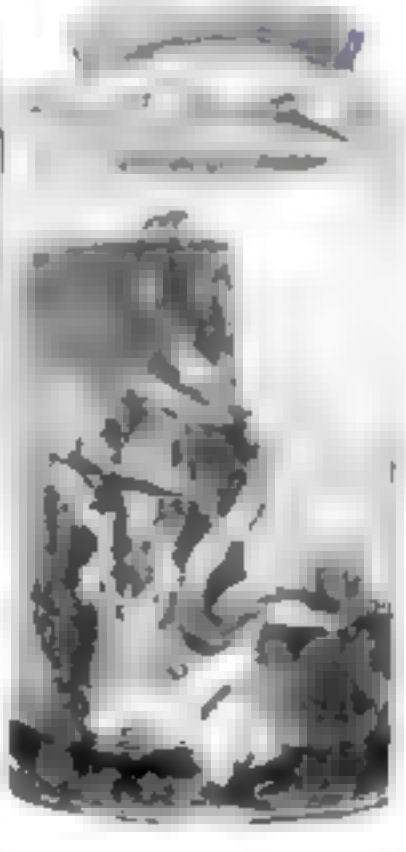
As with [Continued on page 114]

The Deadly Venus Fly Trap

The greatly enlarged photographs above graphically show the suppleness and deadliness with which the Venus fly-trap catches its prey. As seen in the lower picture, the fly is locked fast in the tightly folded leaf

It Digests Insects

One of the most fantastic insect devouring plants of all is the goose plant. In the photo at the right it is shown with its jaws, ten inches wide, pried open with a stick like an alligator's. The second picture shows the same plant with its jaws closed



Fungus—The Criminal of Plants

A tiny piece of fungus was placed on a block of spruce in the jar at the right. In less than nine months, the block was rotted throughout. Molds, mildews, mushrooms are a few of the grafters and bandits that make up the large and noxious criminal class of the plant world

Sharpshooting *at the* Atom

How the Marksmen of Science Bombard Invisible Specks to Break Open Vast Stores of Power

By G. B. Seybold

IMAGINE two teaspoonfuls of water producing 200,000 kilowatt hours of electric current worth $20,000! Or imagine one pound of gold, costing $320 at present prices, yielding a billion dollars' worth of power—ten billion kilowatt hours—as much as the annual capacity of the great Fundy Bay water power project, and four times as much as Muscle Shoals!

Such things sound entrancing! Yet they will actually come to pass, we are told, once science finds the key to release the tremendous stores of energy locked up in atoms—the invisible, mysterious specks of matter that compose all substances. For years workers in the laboratory have been searching for the entrance into this storehouse of power. They are still at work. Just how far have they gone toward mastering the secret?

In various ways scientists are following the path pointed out by Nature herself, trying to release the energy through transmutation of elements. In her family of radioactive substances Nature shows how self-generated rays of energy are thrown off while she turns uranium, thorium or actinium gradually into lead. She takes her time about the process. Before uranium makes its first transmutation — and there are sixteen changes to make before it finally becomes lead—a period of five billion years elapses. And even then half of the mass of uranium remains as before. This slow release of energy would never run a sewing machine and so far, no way has been found to speed up the natural transitions.

TO EXTRACT any practical value we need an artificial means, a quick way to get at the atom's power, and it is here that scientists have made progress. Sir Ernest Rutherford in England has produced energy by transmuting six elements—and very unwilling the elements were about it! Professor Adolph Miethe of Berlin and Doctor Hantaro Nagaoka of Tokyo claim to have turned a seventh element, mercury, into gold. An eighth element, the metal tungsten, has been turned into the gas, helium, by two Americans, Dr Gerald L. Wendt and C. E. Irion. Dr Arthur Smits and Dr A. Karssen of Holland have produced mercury from lead!

So far nearly ten percent of all the elements have been transmuted. Not bad for a work that started only in 1896!

All are agreed that the change comes and the energy is released when an atom is smashed, that

Courtesy Science Exhibition Committee of the Royal Society

The Sound of Atoms Heard on a Loudspeaker

With this remarkable apparatus, demonstrated in England, individual atoms thrown off by a radioactive substance can be made to produce audible sounds. As atoms strike an electrified surface, the sound of the impact is amplified

wreckage flies about. Smashing an atom means changing the relative number of positive or negative charges in it.

According to the accepted theory, in every atom negative charges called electrons revolve around a nucleus made up of a corresponding number of positive charges or protons, as planets go around the sun. The sole difference between various elements lies in the electrical charge in the nucleus and the number and arrangement of electron "planets" in its atoms. An atom of gold, for example, has seventy-nine electrons, while mercury [illegible] or an even eighty.

[illegible] one element into another and release energy, it is necessary not only to knock out one or more of the whirling electrons, but to break into the nucleus to get rid of the corresponding number of positive charges there. This is the tremendous task.

DR R A MILLIKAN of the California Institute of Technology has pulled electrons out of certain elements—"stripping them," he calls it—and he has found that this does not change the elements radically. The nucleus of the atom then, must be the bull's-eye. And since the nucleus is almost unbelievably small, the difficulties of "hitting the bull's-eye" become tremendous.

To form an idea of just how small the nucleus is, consider the size of the atom of which it is a part. If every man, woman and child in the United States were reduced to the size of an atom we could all find standing room on a fifty-cent piece and there would be space left over for us to stroll about. In exact figures there are 100,000,000 atoms to the inch.

THE nucleus, which the scientist must work with, is only the hundred thousandth part of the atom. The rest is blank space in which the electrons are revolving, at a speed as high as 90,000 miles a second. Sir Ernest Rutherford at Cavendish Laboratory, Cambridge, has achieved his results by shooting at the nucleus of the atom with the most powerful projectile in the universe, the swift "alpha" ray of helium obtained from radium and thorium. Traveling at a speed of 10,000 miles a second, this hits the nucleus with a velocity 20,000 times that of a rifle bullet and with a force which, mass for

(Continued on page 176)

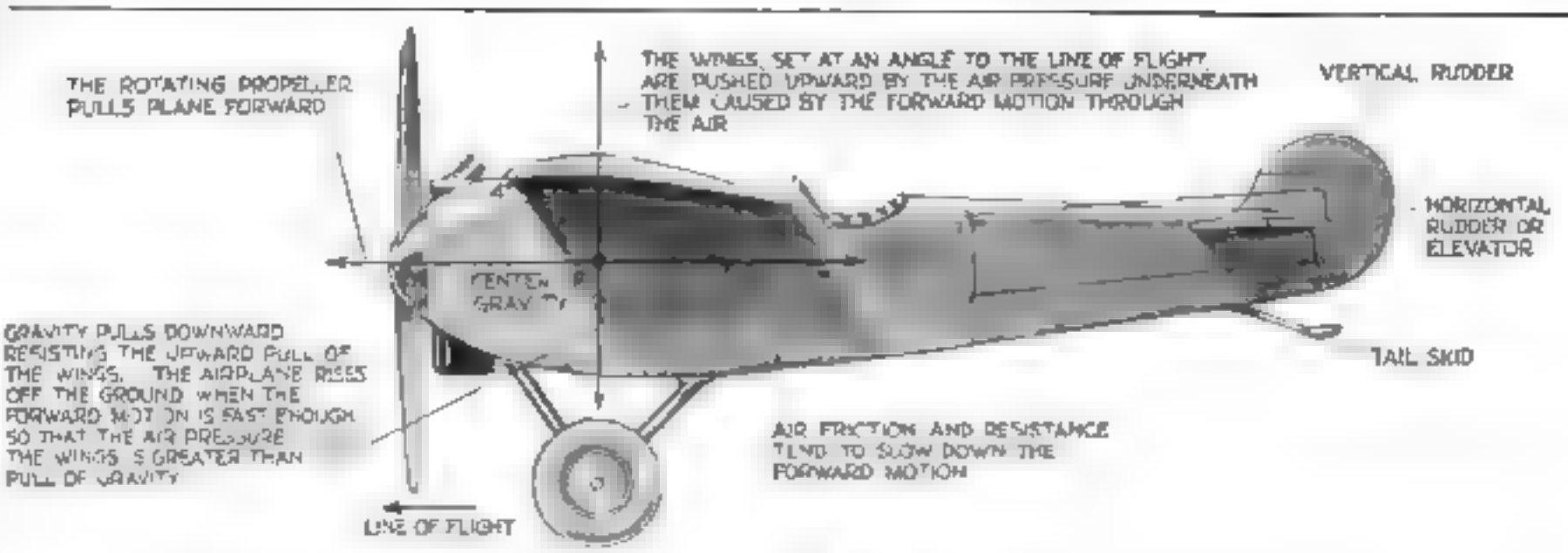
How to Make Gold from Silver

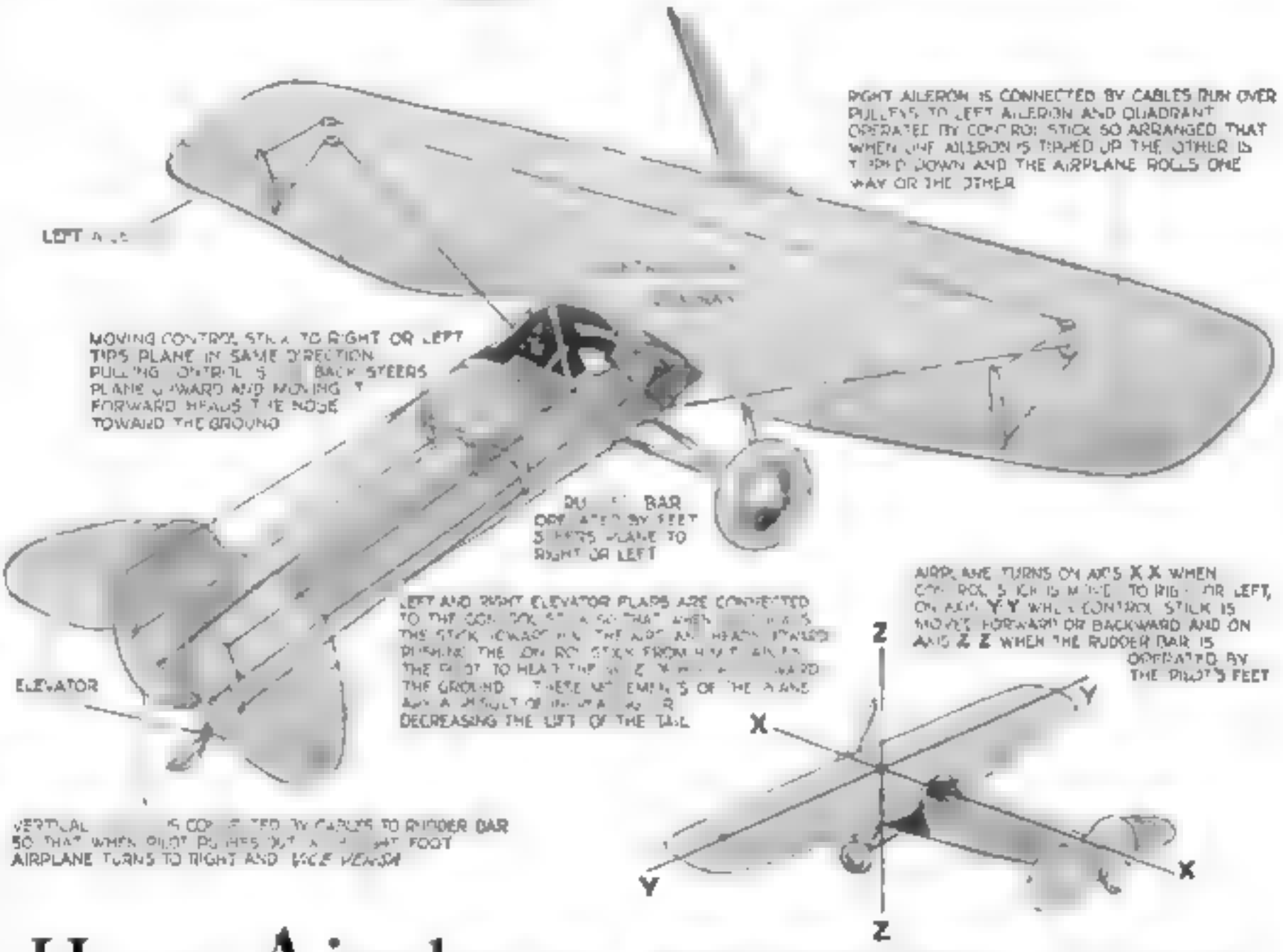
ANY amateur chemist can try the experiment of making gold in the laboratory. Here is the formula, as followed by the French Society of Alchemists in turning silver into gold, and announced recently by M. Jollivet Castelot president of the society.

To 125 parts of pure silver add seven parts of bisulphite of arsenic and three parts of sulphide of antimony. Melt and keep at a temperature of 1,000 degrees centigrade for four hours. A yellowish metal results. This must be melted, and ten parts of the arsenic compound and five parts of the antimony compound added very slowly. Keep temperature at 1,000 degrees centigrade for four hours.

Now add ten parts of potassium nitrate, ten parts of ammonium chloride, ten parts of borax and some powdered soap, the latter being supposed to purify the metal, which by this time has become white. Cool, and the residue will contain one-fourth of one percent of gold.

If you hope to make any money from the process, however, better not waste your time, for it takes about $500 worth of silver for every dollar's worth of gold produced.





How Airplanes Fly and Turn

THESE drawings, prepared from sketches made by Major Victor W. Page, Air Service, O. R. C., show why an airplane flies and how it is controlled by the pilot.

Unlike an automobile, which has but one direction control, the steering wheel, the airplane must be steered up and down as well as sidewise and must also be kept flying on an even keel in spite of air pockets and conflicting currents.

In straight flying, the pilot's job is to regulate his direction and altitude by slight movements of the rudder bar and the control stick in the backward and forward direction. When he runs into turbulent air currents that tend to upset his ship he moves the control stick to right or left to bring it back to an even keel. To make a sharp turn, it is, of course, necessary to tip the plane in the direction of the turn—in other words "bank" it.

Modern airmen have so mastered the use of the controls that they can perform amazing feats—nose dives, tail spins and so on—as well as bring their ships out of almost any kind of a twisting fall, provided they are far enough above the ground to permit the controls to have any effect.

The Right Material

Wood Is Generally Less Expensive Tile Last Longer—Climate

By JOHN R.

The same house in different dress—

frame

Wood is most locally the cheapest material but is not as lasting as others. The four houses here shown are all made from the same plan, of different materials. The one above is built of wood

"WE JUST can't decide what material to build our house of, so I told Rob we'd ask you," explained the vivacious young woman who had ushered a tall husband into our living room.

"That's very flattering," I said.

"Don't think it," was Rob's gloomy comment. "She has her mind made up already and only wants you to O. K. her choice."

"Oh, what a wicked fib!" rejoined Ellen. "I merely said that a house in the colonial style with those wide boards painted white is beautiful. Perhaps a brick house can be attractive, too."

"I'm kind of sold on stucco," quoth the young husband. "You can put most anything under it, they tell me. And for a first-class stucco job you have a choice between two good materials, hollow tile and concrete block."

"Let me see those plans you've brought along," was my suggestion. "Ah! It's a kind of omnibus scheme for doing the same house in any one of four or five materials. The artist's sketches show how it will look in the different types. I don't wonder you folks got into an argument."

It should be said that my young friends live in the Middle West and they plan to build in the outskirts of a thriving little city. They had a carpenter's estimate on the cost of the house in wood frame at $7,800. This was well within their means and they could afford to spend several hundred dollars more for another type of construction, provided they felt it desirable. I gave them a preliminary talk on the wisdom of using handy local material, if any such is available. A New England builder might well build with the surplus stone lying around his site. If you are near a midwest quarry for cut stone look into that material. Take brick, tile or concrete block if these goods are made near by or are readily available at a reasonable price.

"We want the best," asserted Rob.

"Of course. We all do, within the limit of our pocketbooks. The fact is, always bearing in mind the cash handicap, there is not much inherent choice between most of the materials we can get. Quality and workmanship count for more than the raw substance usually put into a dwelling. There is also a large joker in talking about varied materials for a reasonable-priced house, because the different kinds of stuff are only embodied in the outside walls. There is little difference inside with the average house whether it is wood frame, brick, tile or concrete block."

"Then we might as well have that colonial style in wood frame and save a lot of money too," exclaimed Ellen.

"That's a jump at conclusions. I did not mean to depreciate the value of masonry in outside walls. Even part masonry gives some fire safety, reduces upkeep and tends to keep out both winter cold and summer heat. Wooden houses have lasted a century or more. If you have a small plot and are going to be elbowed on each side by frame dwellings, I'd advise as much masonry as you can afford and a spark proof roof. Wood is the cheapest material, easiest and quickest to build with in any shape or form. It tempts not only the slim-pursed but the rich, who put up sprawling palaces of it instead of more mansions in masonry that the same money would provide for. Don't choose wood just for the sake of a better show."

"I guess that lets out the frame colonial," said Rob cheerfully.

"NOW, Rob," I admonished as his better half made a face at him, "stucco, which you may favor, has false-front possibilities also. The other day I saw a new house being built of rugged blocks of cut stone, apparently. A nearer view showed that those blocks were a thin veneer of fake substance nailed to wood sheathing. Wood does not make false pretenses, anyhow."

"Thank you for those kind words," quoth Ellen. "Now would you mind telling us about these plans in brick—cost, looks and everything?"

—brick

If you can spare the extra cash, brick construction will repay you in reduced upkeep, slower depreciation and easier heating. The house above shows the "homey" effect builders can achieve with brick used as the material

Photo, Home Owners' Service Institute

"Just a moment until I figure. For brick exterior walls we'll allow twelve percent more than for wood frame. Let's see. It brings the price up to $8,736, or a net excess over wood of $936. That is quite a difference and brick advocates must talk to the point, if they're going to convert us. Well, they say if brick costs more at first it will be less expensive in the long run. Less depreciation and upkeep. Here is a printed comparison between a brick and frame house, giving the yearly cost of painting the latter as $100 against $8.50 for the other. Fire insurance, put at twelve dollars a year for brick, is said to be twice as much for frame. The wood house starts to depreciate right off at the rate of three percent annually while the brick stays like new the first five years and then gently toboggans at the rate of one percent a year. The cost of heating also increases with frame when warping and shrinking make drafty outer walls."

YOU take some of that brick talk with a grain of salt, don't you?" asked Rob.

Sure, same as other special argument. Yet brick masonry does stand the punishment of time and has long-run economy. It is favored by the fire underwriters and by the building codes. It should be used more in homes. An eight-inch wall, which means the thickness of two bricks,

to Build With

to Use, But Brick, Concrete and and Region Should Decide

McMAHON

—hollow tile

Above is the hollow tile version of the same house shown at the left and on the opposite page. It ranks next to brick for strength and fire resistance and is usually but not always successful

concrete block

Costing nine per cent more than the same house in wood, concrete block above can be used with or without stucco. The large size of the blocks speeds masonry work and they come in most of the handy fractional sizes needed

—Each material has advantages

laid flat is enough for any dwelling.'

"But you can't make it look well in a small house like ours, can you?" inquired Ellen.

"Architects and bricklayers have improved in that respect," was my reply. 'They are now turning out some mighty neat and cozy looking homes. You can choose from a great variety of handsome bonds or styles of laying brick. You can get a fine artistic and homey effect by haphazard brickwork, odd sizes and all put in the masonry without any regular line or pattern. There is also a clever method of laying outside brick so they stick out irregularly from the wall surface. What for? It's like a painting in which a close-up shows gobs of pigment strewn on the canvas, but at the right distance you appreciate the effect. The irregular wall gives play of light and shade. It makes interest and beauty.'

"I UNDERSTAND they have hollow walls of brick," remarked the young husband. "How about them?"

"They save material and seem to be a good bet. They began to be used in small houses on the Pacific coast and are now quite popular everywhere. Really, this method is old stuff in Europe and so much the better from the standpoint of tried and proven. A hollow wall is made by laying some or all of the brick on edge. The air space makes it drier than solid masonry. It has enough strength and fire resistance, though it is not equal to solid brickwork in these respects. An eight-inch wall called all rolok, which is one of the hollow types, is produced by a series of two edgewise bricks running the length of the wall, their ends joined or closed by header bricks also on edge. Thus saves one fourth the number of brick needed for a solid wall, one third the amount of mortar and some labor.

"How do they treat the inside of those walls?" pursued Rob.

'Well, in California and other dry sections they often plaster direct on the inside of both hollow and solid masonry. It is not a good practice for most of the country, regardless of precautions like dipping the inside end of the header brick in a hollow wall in waterproofing compound. Outside of a bone-dry climate every masonry wall, brick or anything else, should be furred with wooden strips so as to make an air space under the final interior covering.

"But you say there is more than one kind of hollow wall in brick?" inquired Rob.

"YES. With the so-called rolok-bak the outside courses of brick are laid flat as in regular masonry while the inside courses stand on edge. Every six courses of the flat brick the twin walls are bonded together by a continuous row of flat crosswise brick—headers, they call 'em. In this style you have the same width of wall as the other hollow method, but it takes somewhat more material and labor."

"Once I saw a pile of funny looking bricks with a sign on them 'Bargain - Seconds,' remarked Ellen. "Would they be good?"

"You missed a rare chance if those were clinkers or skittles. All colors, weren't they, from coal-black to orange? Misshapen, too? An architect would jump at the chance to have them for the sake of their variegated form and color. He would put them right around the front entrance of a house. Those bricks were produced by the chance of overburning, being placed too near the fire in the kiln. I guess I don't need to tell you that we have been talking mostly about common brick. Face brick which cost twice as much or more are used for fireplaces and to veneer fronts of buildings.

"Give us some dope on the hollow tile version of our house," suggested the young husband.

Right. First I'll estimate the cost. At ten percent more than wood frame it comes to, say, $8,500. Now hollow tile is burned clay same as brick, only it has air spaces and is made in larger units. A standard size is a foot long by eight inches the other two dimensions. Since this is equal to a dozen bricks you can see that a mason can lay tile pretty fast. But the time he gains here he may lose when he comes to stucco the tile job. The fire underwriters rank hollow tile close to, if not on a par with brick, and they lose a notable strength as well as fire resistance."

"YOU had me converted to brick," said Rob, "and now you have me leaning to tile. Can't you be less impartial?"

"Don't be foolish, Rob," I replied sternly. "Suppose I gave my personal preference for both brick and tile used together? And that might not apply to one region and one climate. Eiderdown shirts are fine in the Arctic but mutton feels better in the South. Are you squelched? Now tile has its variety as to the number of air spaces across the wall, usually two, and as to the placing of air spaces, whether vertical or horizontal. In some kinds no mortar joint extends through the walls, which stops moisture getting in. There are tile sizes and shapes to fit door and window openings, in fact to meet every building need."

"I have a question before Rob wins another foolish prize," said Ellen. "Maybe mine will too. (Continued on page 118)

"We Can *Trick* the Wind

That Is the Rotor Ship's Inventor — A Boy's

Anton Flettner, the "rotor ship man," himself regards his amazing invention chiefly as a fuel-saving device, to supplement rather than displace motors. At right: The newest motor ship, the 3000-ton *Barbara*

How the rotor principle works: The rotating mast resolves the force of the wind into suction and pressure in the zones indicated by light and dark areas. The forces are at right angles to wind

By Robert E. Martin

EVEN in a modern age of steam and electricity and gasoline engines, the wind still howls as hard as ever. As a source of driving power, the wind remains quite as available and quite as cheap as it was in the beginning of time. It still blows everywhere without cost, and it is free to anyone who will use it.

Notwithstanding many generations of dependence on the wind, most of us were ready to lose sight of these facts when, a few weeks ago, a 31-year-old inventive genius blew in from Germany to remind us most forcibly of their truth. His reminder was in the form of as strange a ship as ever sailed the sea—a craft with odd spinning funnels that caught the breezes and harnessed them.

As Anton Flettner's rotor ship, the *Baden-Baden*, sailed into New York harbor, welcoming crowds regarded her at first as a sort of mysterious "freak" of invention. Since then, this strange vessel and her young inventor have remained to demonstrate to the foremost power-using nation on earth that the wind, as a cheap and efficient source of usable energy, is far from being a back number.

We were beginning to think it was. After mariners for thousands of years had set billowing sails to the breezes, we saw the sailing ships vanish from the seas. After centuries of whirling windmills, we saw the picturesque towers falling to decay, and the wide wings tattered and dejected. Served instead by tremendously efficient power drawn from the coal and oil of the earth and from the discoveries of electricity—with our motor cars, motor ships and all the rest—we were ready to place wind power among the "has-beens" of history.

It remained for the genius of Anton Flettner to reawaken us—to prove that it is not the wind itself, but rather man's method of capturing the wind, that has run out of date. What he has done is simply to find a new and better way.

The rotor ship *Baden-Baden*, which astonished thousands of us during its visits to American ports, is the first application of Flettner's revolutionary ideas. It is only a beginning. Its real importance lies not so much in its immediate proof that wind power can be used effectively as a fuel-saving auxiliary for steamships and motor ships, as in the vast possibilities it offers in the future for cheaper power on land as well as on sea.

Flettner's invention, as described in detail in the February, 1925, issue of Popular Science Monthly, is simply the application of the scientific principle, known for nearly three-quarters of a century, that a cylinder rotating in the wind exerts a force at right angles to the wind. On the side of the cylinder moving against the wind, the air "piles up" and exerts pressure. On the opposite side suction is created, exerting a pull. Of the total force on the cylinder, about seven-eighths is due to suction, and one-eighth to pressure. And this force, Flettner has found, is ten times as great as that produced by an equal area of canvas sail.

The metal-sail boat, a boyhood exploit that marked the first step toward the rotor ship

Cheaper electricity may be a widely beneficial application of the rotor idea. The first rotor mill in Berlin is designed to run a power and light plant. Other wind plants are being built

"Blue coal" is the name applied by the inventor to the wind-fuel he has thus reharnessed for the use of mankind. "It is wonderfully cheap," he tells us, "and it is available to the world in billions of horsepower."

JUST when, where, and how extensively it will be made available not even Flettner himself has been able to predict with certainty. The idea is still in its babyhood. Its possibilities seem almost limitless. We do know, however, that the first Flettner rotor windmill is being operated by the city of Berlin and is reported to be at least thirty percent more efficient than the best of the old-time sail windmills, also that a second rotor mill, capable of developing 2000 or more horsepower, is being completed. We know, too, that the same principle recently has been applied by certain American automobile

into Saving Billions!"

Real Significance, Believes Its Idea Amazes the World

manufacturers in rotor ventilators for closed cars, that Flettner is working on other industrial applications, and that he even predicts that rotors eventually may replace the wings on airplanes. Finally, we know that the world is eager for just such a source of cheap power, for the irrigation and reclamation of vast desert lands, and for industry in regions where water power is unavailable.

BILLIONS of horsepower absolutely free. Anton Flettner seems to have been born with a genius to sense the wasted force of howling gales, and to devote his inventive mind to their mastery. Sprung from a long line of seafaring men, his first dreams of invention began when, as a boy, he sailed before the mast in his father's ships. To him the elements were an endless source of wonder. When a hurricane struck his vessel off the Gold Coast, he was inspired by the tremendous power lost in the gale. Concerning a plan for a "wind turbine," he drew rough sketches—enough to convince him that he would need more technical knowledge before he could carry his dreams to completion. He left the sea and went to school. For five years he devoted himself to physics and higher mathematics, first at Frankfort-on-Main, near his birthplace, then at Berlin.

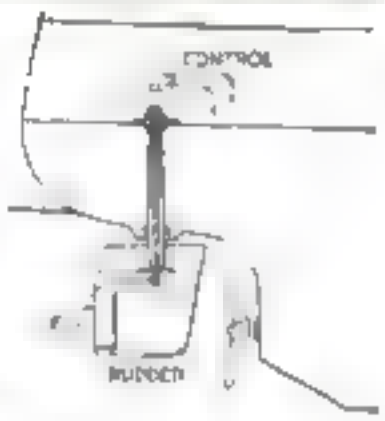
His first creation was an invention which not only failed but nearly ended in disaster. It was a metal sail, somewhat like an airplane wing, designed as a substitute for canvas. He strung it on the rigging of a small boat and set out. In a light breeze the boat almost capsized and its frightened creator quickly sped back to port. Yet this first attempt, futile though it was, at least marked a step toward the invention of the metal rotors which eventually were to drive the *Baden-Baden*.

Another boyhood invention which also barely missed a tragedy was a method of wireless control of moving objects at a distance. Anton then a youth of seventeen could find only one man who saw any use for it. That man was the owner of a circus. He commissioned Flettner to build a device that could put a riderless horse through its paces from a distance. The machinery was to be hidden in the saddle.

On the first trial the horse displayed a strong dislike for the mysterious saddle. It bucked so violently that it jammed the delicate control mechanism out of order. Left to its own devices, the machine began to jerk and whip the reins with such wild abandon that the horse jumped a fence and ran away. That was the end of wireless control for Flettner for the time being, although in later years, during the World War, he was to develop a system of radio control for army tanks and airplanes which went through paces that amazed high army officers.

MEANWHILE during his search for a new way of capturing the wind, Flettner hit upon the idea of a free-swinging rudder, one of the most valuable of all his inventions. At the outset this startling departure from the common hinged rudder met only with ridicule. Technical experts scoffed at the idea that a rudder, free to swing on its axis like a weather vane, could possibly influence the course of a ship. In fact, experts in a German patent office refused the young inventor a patent, accompanying their refusal with a lengthy document containing complicated mathematical calculations to prove that the rudder could not possibly work!

"All right," said Flettner, "I'll prove their calculations are wrong." And he did. He has lived to see his invention installed on more than a hundred ships, large and small, and on at least five hundred airplanes. Today no rudder is being adopted by shipbuilders the world over. The secret of its operation is a small panel, or fin, set into the tail of the rudder. This fin, rather than the main rudder, is controlled by the navigator. He simply swings the fin, the fin steers the rudder; the rudder steers the ship.

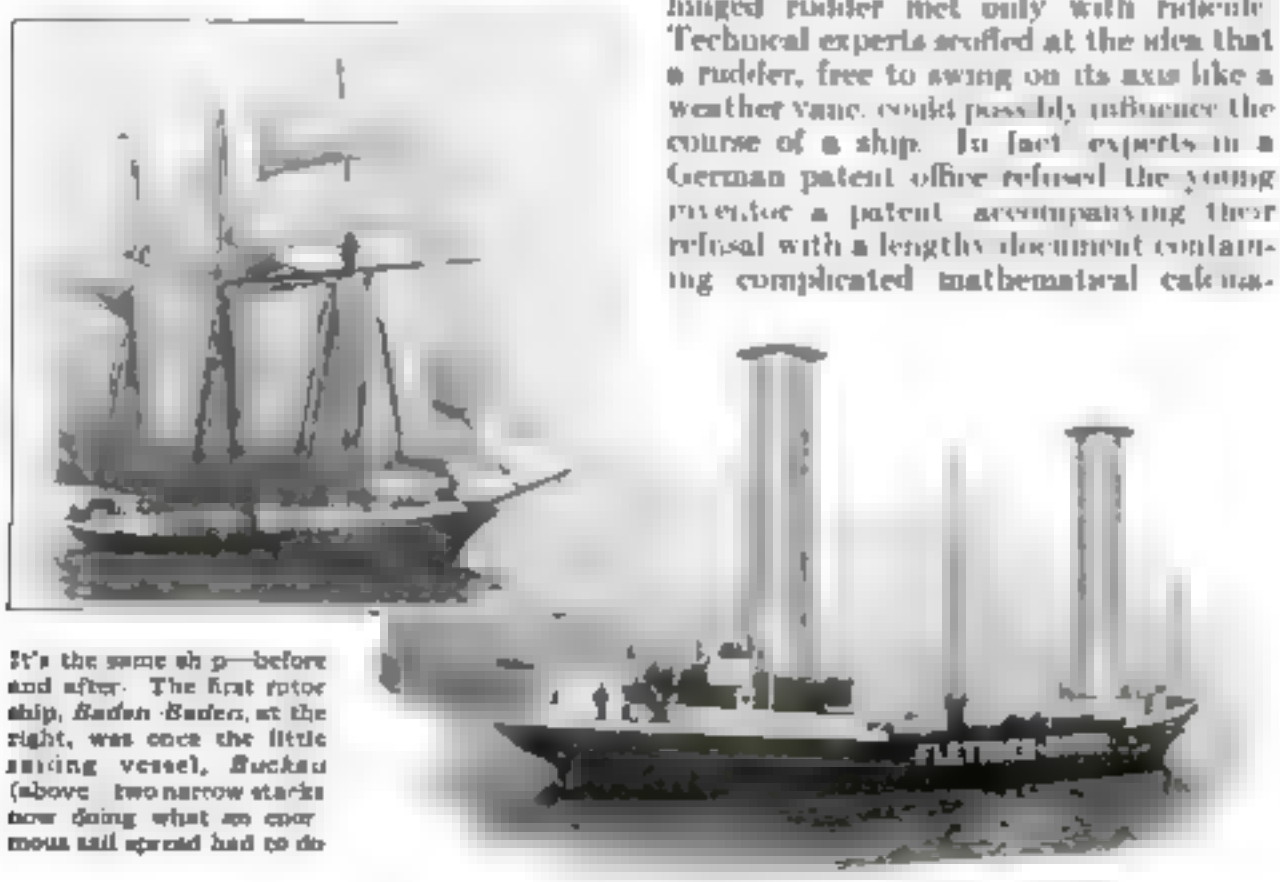


Shipbuilders the world over are adopting another of Flettner's inventions: the free-swinging rudder. The secret of its operation is a narrow panel or fin in the picture above, shown along the extreme left of the rudder. The navigator swings the fin, the fin steers the rudder, the rudder steers the ship. At the right is shown a diagrammatic explanation

WHEN the fin is set at an angle to the rudder, it swings the latter to a position where water pressure on rudder and fin are balanced. Even if the impact of a big wave temporarily upsets this equilibrium, the rudder immediately returns to its former position of balance.

The increased safety and economy of such an arrangement are obvious. Control of the Flettner rudder requires only about five percent of the power needed to manipulate an equally large rudder of the old type. Even a ship of 1000 tons may be steered by hand.

From the difficulties he encountered in convincing experts of the practicability of the rudder, Flettner knew that he would have even greater trouble to "put over" the rotor ship idea, which he eventually developed out of the failure of his metal sail. He was not far wrong. When he tried to explain the rotor to technical men he found (*Continued on page 106*)



It's the same ship—before and after. The first rotor ship, *Baden-Baden*, at the right, was once the little sailing vessel, *Buckau* (above), two narrow stacks now doing what an enormous sail spread had to do

Keeping Up *with the*

World's End 999,998,000,000,000

Flower Lives in Sealed Bulb

The young woman above is holding a plant growing inside a hermetically sealed bulb exhibited recently at a convention of scientists in Washington, D.C., to show a plant does not need fresh air. It uses the same water and air over and over again and needs no attention whatever

On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our every-day problems

Canning Preserves Food Values

AT LAST there comes a ray of hope that the comic artist will have to abandon his timeworn joke about Mrs. Newlywed and the dinners she cooks with the can opener.

Dr. Walter H. Eddy astonished members of the New York State Medical Society not long ago by declaring that the process of canning, instead of killing nutritive values of food, actually preserves them. He believes the impression that canned foods are less healthful is based on a mistaken vitamine theory

For example, there is five times as much vitamine C in canned cabbage as in boiled fresh cabbage, he said.

No Need to Fear End of World

FOR a while, at least, we don't have to worry about the world's coming to an end. After doing a bit of simple figuring with bewildering rows of ciphers, Professor F. R. Moulton of the University of Chicago now assures us that our earth still has some 999,998,000,000,000 years to go on whirling around the sun. Here's the way it works out:

Geologists say that the earth now is two thousand million years old. The average life of a planet such as ours, says Professor Moulton, is one quadrillion years. To get an idea of how long that is, multiply a million by a million and then multiply the product a thousand times. Put these figures down, and you will see that our earth, on its two thousand millionth birthday, is just a newborn babe as planets go. According to the professor's figures, it will keep on living nearly half a million times as long as it already has lived. So why worry?

Our Huge Mosquito-Bite Bill

IN YOUR household budget, along with the items of grocery and butcher bills, have you figured on the summer expense of mosquito bites?

Statisticians who have been following the trail of the buzzing pests tell us now that every man, woman and child of us paid, on the average, the sum of ninety one cents last year just for the privilege of being bitten. The national mosquito-bite bill was $100,000,000!

This sum, we are informed, represents the damage done by malaria mosquitoes in bringing on some 1,000,000 cases of chills and fever. And there is little hope of the price being reduced this summer.

Around the World in 17 Hours

AFTER studying the flight of birds for centuries, man at last has learned to fly, and in doing so he has outdistanced his living models in speed, in altitude and in carrying ability.

Now a study of the marvelous flying mechanism of the world's speediest known creature, a South American fly known as *Ephemeroptera*, has led at least one scientist to suggest the possibility that eventually airplanes may nearly triple the present airplane speed record of 300 miles an hour.

Dr. Charles H. T. Townsend, American entomologist stationed at Itaipuquevetube, Brazil, points out that if we can learn to duplicate the action of *Ephemeroptera* we shall be able to fly around the earth between sunrise and sunset of the longest summer day, or in about seventeen hours. To do this over the 13,800-mile circuit at the latitude of New York, we should have to travel constantly at a speed of 814 miles an hour or almost fourteen miles a minute! This is as fast as the speed of projectiles of certain types of artillery.

It sounds like a "pipe dream." And yet, as Dr. Townsend recalls, it was not so long ago that people gasped at the thought of traveling "a mile a minute." He reminds us, too, that it is not beyond the possible for man to duplicate with machines what other creatures have accomplished in natural locomotion.

The fact remains that *Ephemeroptera* does cover 815 miles an hour, or nearly 400 yards a second. With tremendous power stored in a body of extremely light weight, it moves so swiftly that it can be seen only as a blur or streak of color.

Tides Start Volcanoes Going?

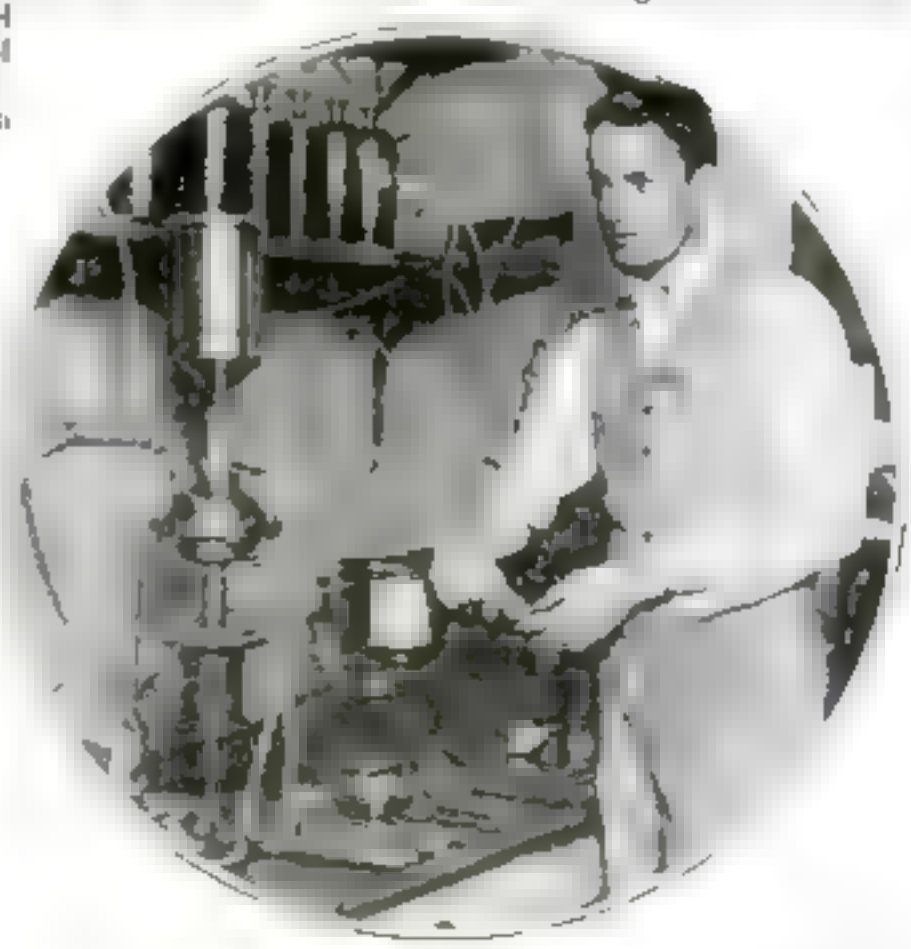
AN INTERESTING solution of the mystery of volcanic eruptions has just been offered by William Bowie of the United States Coast and Geodetic Survey. He advances the theory that volcanic outbursts may be due directly to the pressure of the tides, which twist and wring the earth.

This theory is based on a study of Bering Sea, where tidal pressure is unusually great and where volcanoes are found in greater number than in any other spot on the earth. The tides also may have an influence in building mountains.

Psychologist May Rival Doctor

SO RAPIDLY is psychology advancing to a pace of vital importance among the applied sciences, that before long we may call upon the professional psychologist for a prescription for "brain fag" as readily as we now turn to our family physician when we are physically "run down."

The trend in this direction was strikingly illustrated recently when President W. H. P. Faunce of Brown University announced that "the mental and spiritual needs of Brown undergraduates hereafter



Obtains Fuel Gas from Refuse Oil

At the age of nineteen, Robert Lawrence, Jr., of Washington, D. C., has completed an invention which it is believed may have wide effect on industry. It is a machine, run by electricity, which is said to extract a high grade of fuel gas from refuse oil. Eminent engineers say that the invention will be of great value in the heat treatment of steel. The young inventor, seen at the right with his device, began working on his machine when he was thirteen years

Progress *of* Science

Years Off — Some Other Amazing Discoveries

Bell's Original Telephone

Were it not for the fact that inventors keep on making improvements, we should still be using the bulky fog-horn device for telephoning, as shown below, instead of the compact instrument we now use. This weird instrument is the original telephone invented by Alexander Graham Bell and patented a half century ago. It is now at Smithsonian Institution, Washington

A Rubber That Is As Strong As Steel

With feet braced against a bench and his whole weight pulling on it, Dr. C. Moon of the United States Bureau of Standards is trying to stretch a thin strip of a new kind of rubber just developed, which has amazing tensile strength. It is said to have many properties which are causing manufacturers to consider using it as a substitute for metal

will be studied by psychologists as their physical ailments now are diagnosed by physicians."

The purpose, he added, was "not mere analysis in the name of half-baked science, but human helpfulness given by the best men in the medical profession."

Hundreds of students, said President Faunce, are held back by mental conditions of which their closest classmates often are unaware.

Skyscrapers 80 Stories Coming

THAT the tallest skyscrapers of today will be dwarfed by the towering structures of tomorrow seems not at all improbable. Only recently combination office and apartment buildings eighty stories high were predicted by Robert M. Catts, head of a New York concern which is planning the construction of great office buildings throughout the country.

The business man of the future will solve the traffic problem in congested centers, Mr. Catts says, by dwelling in an apartment in his office building and rising to his office in an elevator.

Overhead causeways linking combination home and office buildings will further simplify traffic.

Solving the Mystery of Sleep

ONCE more electricity comes to the aid of science in exploring the unknown, this time to shed new light on the baffling mysteries of sleep.

By means of instruments for measuring the electrical resistance of the human body, Dr. Curt P. Richter of the Henry Phipps Psychiatric Clinic of Johns Hopkins University recently discovered that there are at least two distinct kinds of sleep. One is real sleep, with complete relaxation of brain, nerves and muscles. The other is a sort of stupor, a condition resulting from certain types of mental illness. The latter so closely resembles real sleep that it is impossible to tell, from looking at the patient, that he is not actually asleep but intensely conscious.

In his experiments Dr Richter employed a strong galvanometer and specially constructed electrodes. With these he was able to measure how soundly a person was sleeping without awakening him. They showed that the resistance of a patient to a small electric current sent from hand to hand during sleep was centered almost entirely in the skin, and that the amount of resistance increased measurably with the intensity of sleep. When sleep was not sound, Dr. Richter found, the resistance of the skin usually decreased.

Flattest Surface on Earth

Above you see the flattest surface in the world. It was made at the Bureau of Standards, Washington, D. C., by grinding three disks of fused quartz. It is used for testing gages in industrial plants

Find Speed of the Blood

FOR the first time in history, scientists are able to measure exactly how fast the blood flows through the body. This achievement was announced recently by Doctors Herman Blumgart and Soma Weiss of the Thorndyke Laboratory, Boston City Hospital, who declare it will be of valuable aid in determining abnormal conditions, particularly heart disease.

By their method, radium is injected in the left arm of a patient. Carried in the blood stream through heart and lungs, its arrival in the right arm is detected by an electroscope.

For the normal person the average speed of the blood over this course is from fifteen to twenty-two seconds, the doctors report; for a diseased person it is as slow as forty-five to sixty seconds.

Chemical Action Causes Decay

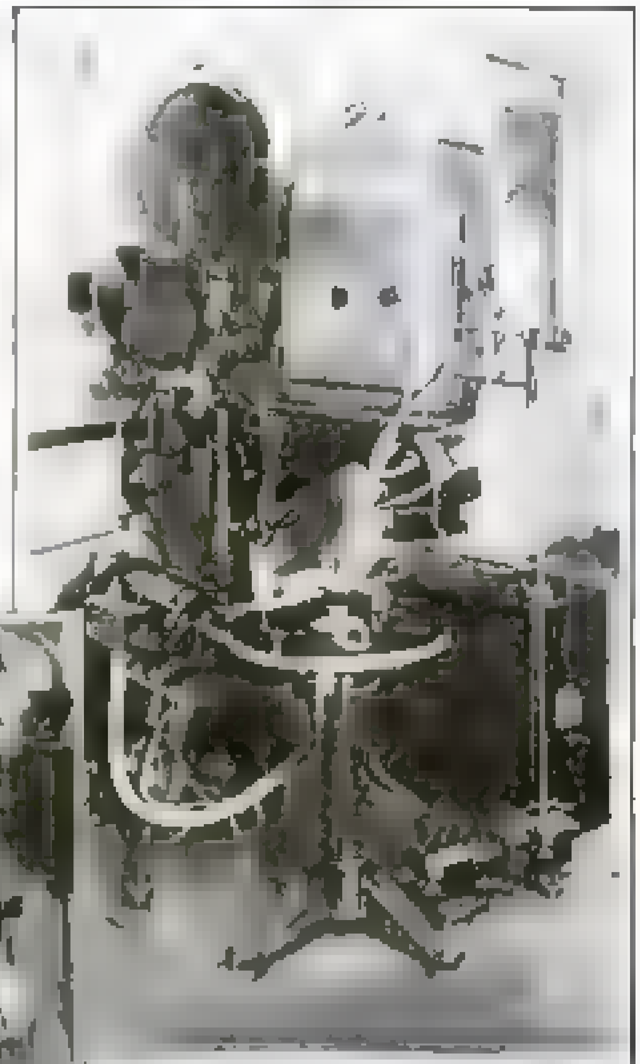
WHAT makes a building decay and go to ruin? Why do chimneys have to be mended so often, especially at the top?

To answer these questions, Dr. E. M. Chamont, professor of chemical microscopy at Cornell University, has undertaken experiments which may save owners of buildings millions of dollars a year.

Dr Chamont believes the chief cause of decay is a kind of chemical action that eats away the structure. He is examining materials taken from old as well as modern buildings that have crumbled.

Talking Movies Astound Auditors

Soundproof camera booth used in making talking movies [illegible] keeps the ticking of the camera from being recorded on the disk



Operating the new talking movie machine is as easy as [illegible]. [illegible] are [illegible] right

Below: The wax disk that takes the sound record while the camera grinds out the film. [illegible]

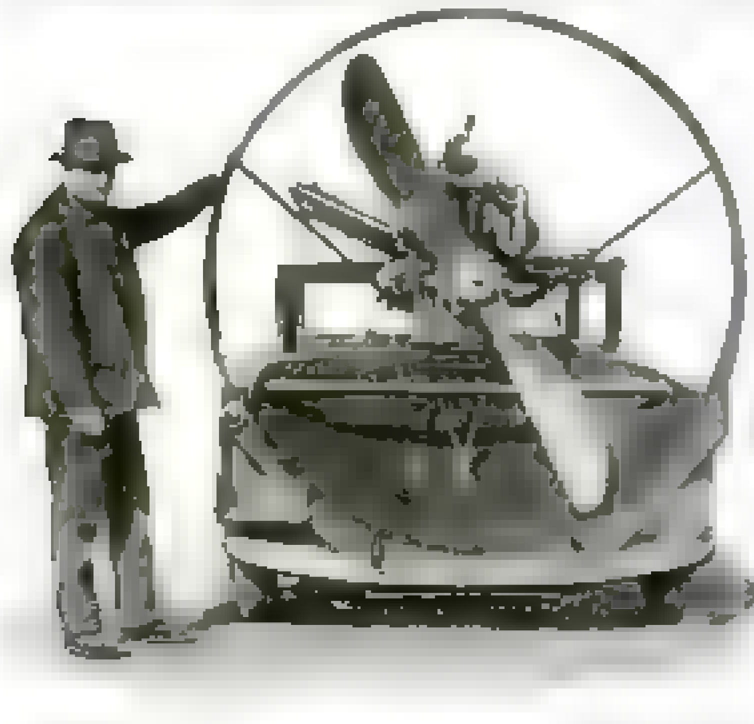
TALKING movies that sound [illegible] to [illegible] that keeps [illegible] the marvel [illegible] new [illegible] worked out by the Bell Telephone Laboratories.

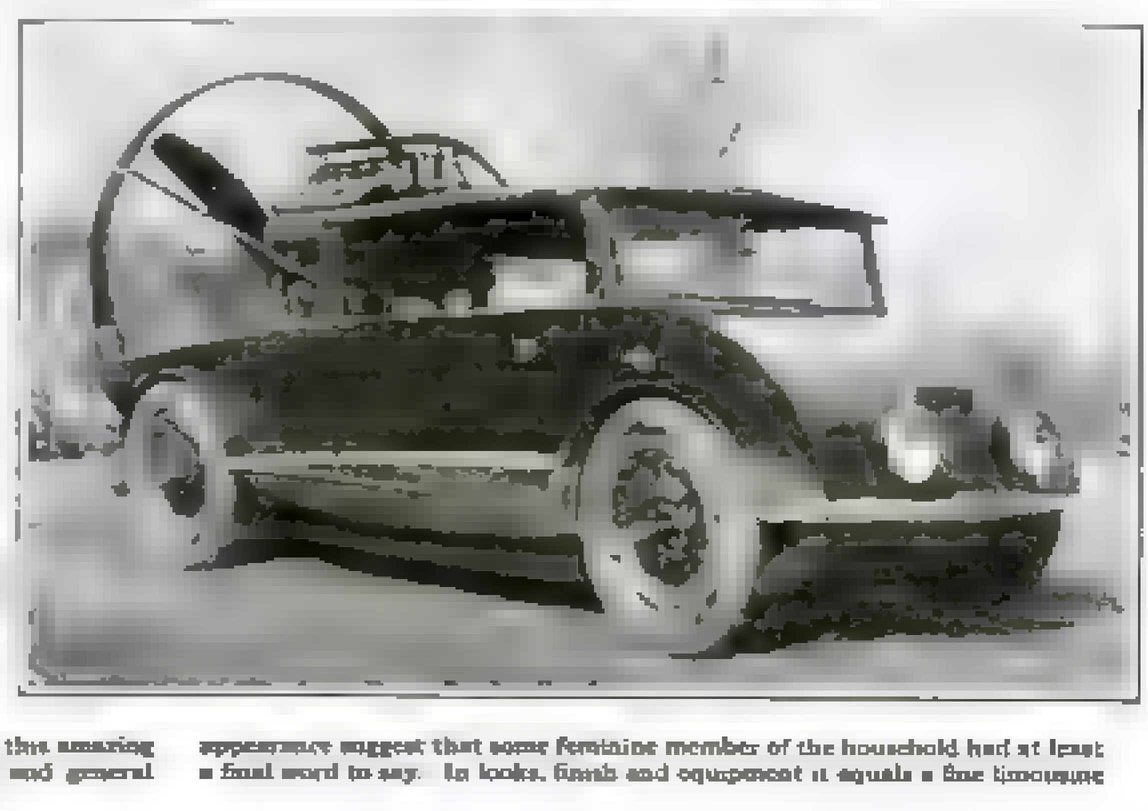
While [illegible] for recording [illegible] brings [illegible]. But the most important part of the new machine is the method of synchronization, a stumblingblock that has tripped up many inventors. This method uses a single motor to drive both the film and the recording disk. One end of the motor shaft [illegible] other end of the shaft rotates the disk. Film and disk are set [illegible] starting mark before the [illegible] is started.

When it is necessary [illegible] camera [illegible] the movies, two motors are [illegible] one to drive the camera and the other to drive the recording disk. An ingenious electrical gearing device has been developed to make the two motors run in perfect time with each other.

It Half Flies on Land, Half Swims in Water

EQUIPPED with a seventy-horsepower airplane motor the astonishing car shown below, which tears across the country at sixty miles an hour, was the idea of George McLaughlin, a Bangor, Me., garage man. McLaughlin doesn't like to bother with bridges when he comes to a river so he made his new car amphibious. Under the running boards are air-tight pontoons to keep it afloat, and it steers by the front wheels in water just as on land. The top is constructed of wood boards in two layers crossed with canvas waterproofed between both to make it watertight and "seaworthy."





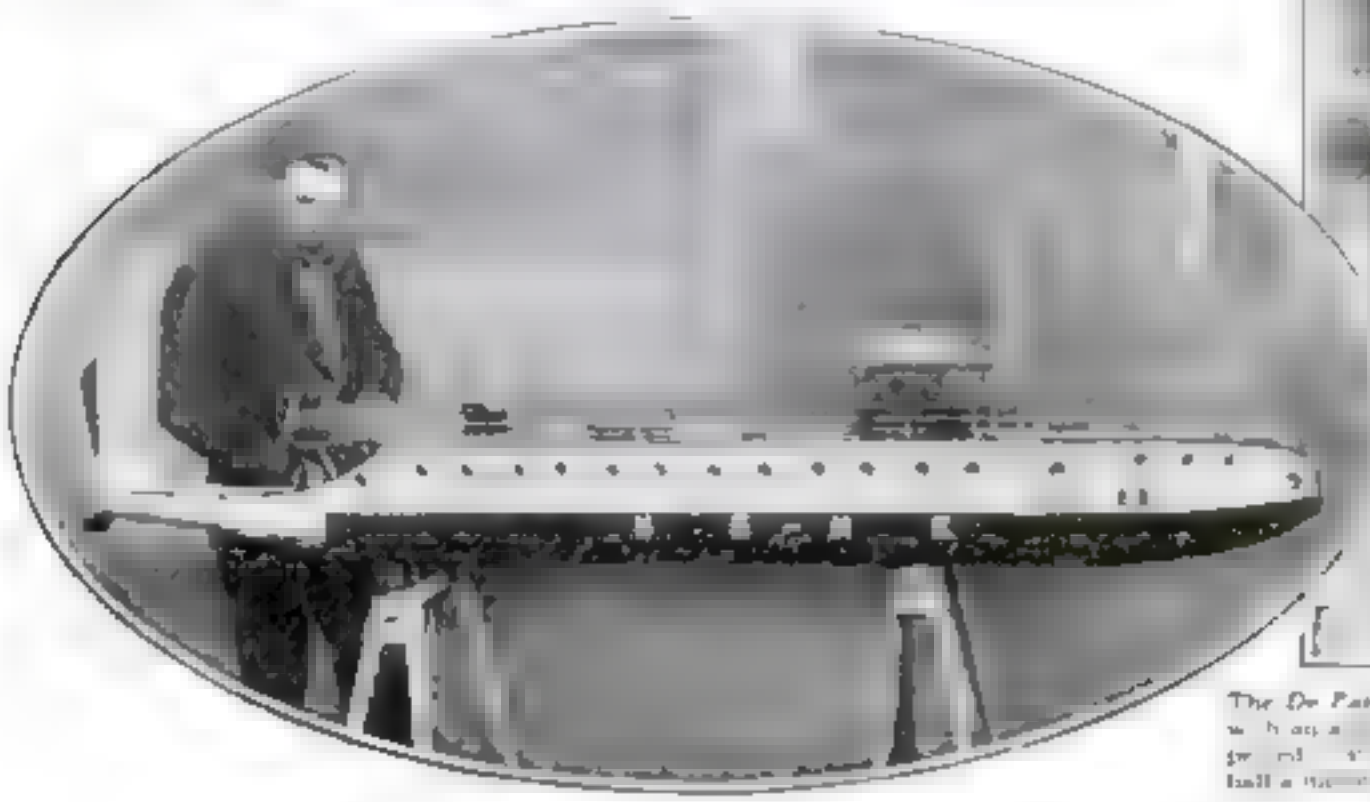
McLaughlin, the Bangor garage man, says he designed and built this amazing flying-fish automobile all by himself, but its roomy comfort and general appearance suggest that some feminine member of the household had at least a final word to say. In looks, finish and equipment it equals a fine limousine

A 90-Mile-an-Hour Boat

NINETY miles an hour is the speed that Colonel Marvel de Passy of Huntington Park, N. Y., expects to attain with the novel racing boat he is now building. The *De Passy 3rd*, as the new racer will be named, is to be propelled by a 400-horsepower airplane motor and a propeller that works against the air instead of the water.

Before proceeding with the actual building of the full-sized racing boat Colonel de Passy experimented with several models. One of them is shown below.

Several unique ideas are embodied in the new craft. In addition to the usual propeller operating in the water, the upper end of the rudder shaft carries a vaneike fin that is directly in the path of the air thrust backward by the air propeller on the giant engine. [illegible] with little frictional resistance. The hull is also of a peculiar shape, resembling a narrow version of the skate fish.



The De Passy 3rd, above. The novel racing boat will be driven by a 400-horsepower airplane engine and propeller, which is expected to give it a speed of 90 miles an hour. Left: Experimental model of boat

Amazing New Motor Runs without Crankshaft or Gears

POSSIBLE revolutionizing of the production of gasoline motors is seen in the invention of an amazing type of engine that recently made a successful airplane test flight at Farmingdale, L. I. Its inventor is Harold Caminez, formerly of the Engine Design Section, U. S. Army Air Service.

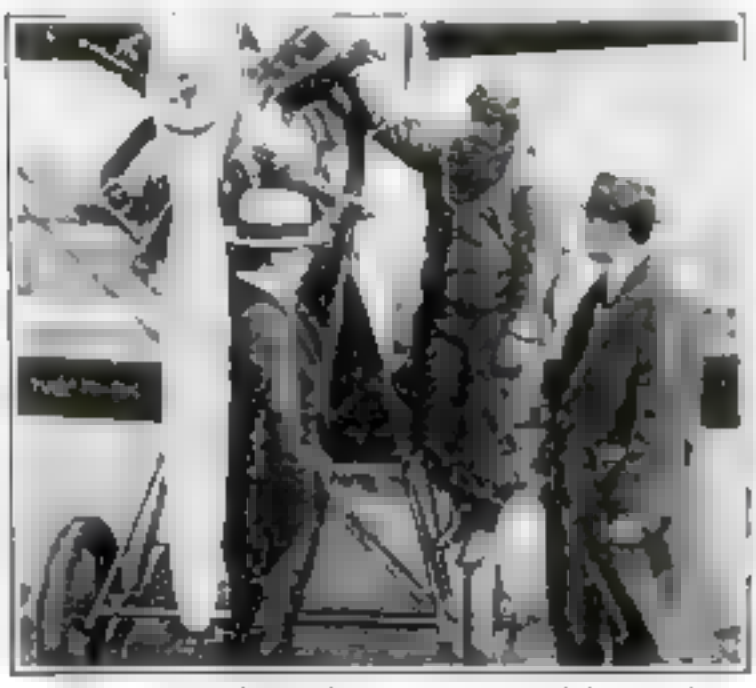
Internally, the novel motor is constructed along radically different lines from other aircraft engines. There is no crankshaft. Nor are there timing gears.

In place of the usual crankshaft there is a plain, straight shaft on which is mounted a large steel cam that is shaped like a figure eight. It is placed directly in line with the centers of the cylinders so that it engages with roller bearings mounted in each piston. These roller bearings are specially built with large diameter outer races. Four lightweight connecting rods or links are so arranged on bearings in each piston that when the cam pushes the pistons in two of the cylinders toward the cylinder head, the links pull the other two pistons down and keep the roller bearings in them in contact with the cam. These links are far lighter than the connecting rods in the ordinary engine, because their only function is to pull the piston down on the intake stroke and they consequently do not have to bear any of the strain of the power stroke.

Gasoline engines of the modern type develop the most power when they are run at high speed, higher in fact than is desirable for best efficiency with an airplane propeller. The new Caminez engine takes care of this difficulty in a most ingenious way. Because the cam is made like a figure eight the pistons make two complete strokes up and down for each revolution of the shaft on which the cam is mounted. In an ordinary engine, the pistons make one stroke up and down for each revolution of the crankshaft. In other words, the shaft of the new engine revolves at half the usual speed. This means high and efficient speed for the pistons combined with the most desirable speed for the air propeller.

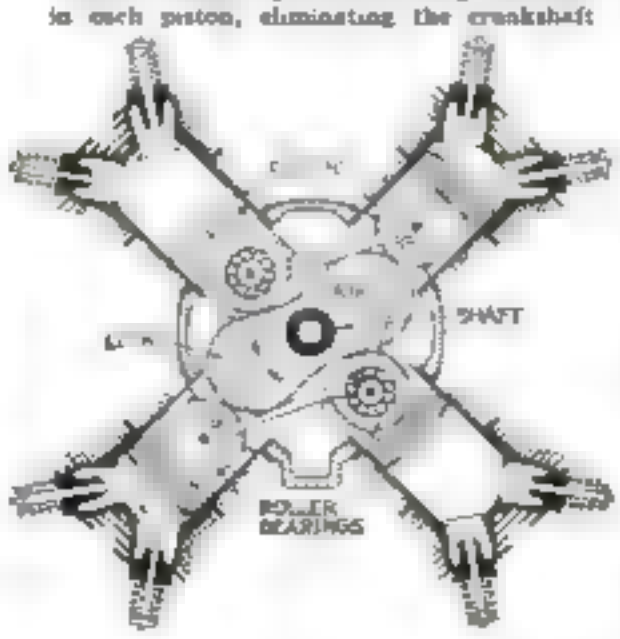
Incidentally, this doubling up of the piston strokes means that no gears are needed to run a cam shaft to operate the overhead valves. The main shaft of the Caminez engine turns at the same speed in relation to the piston movements as does the cam shaft in the ordinary motor. The new engine therefore gets along without cam shaft or gears to drive it, and the cams to operate the valves are mounted on the main shaft.

But of still more importance from the point of view of durability and smoothness of running is the fact that the new engine is the first four-cylinder motor that is inherently balanced mechanically so that there is no vibration caused by the moving parts.



After the test flight of the new engine: left to right, H. Caminez, Capt. R. H. Depew Jr., and S. M. Fairchild

Below: Showing the figure-eight shaped cam, which is rotated by round bearings mounted in each piston, eliminating the crankshaft



Caterpillar Propels Boat for Use in Shallow Water

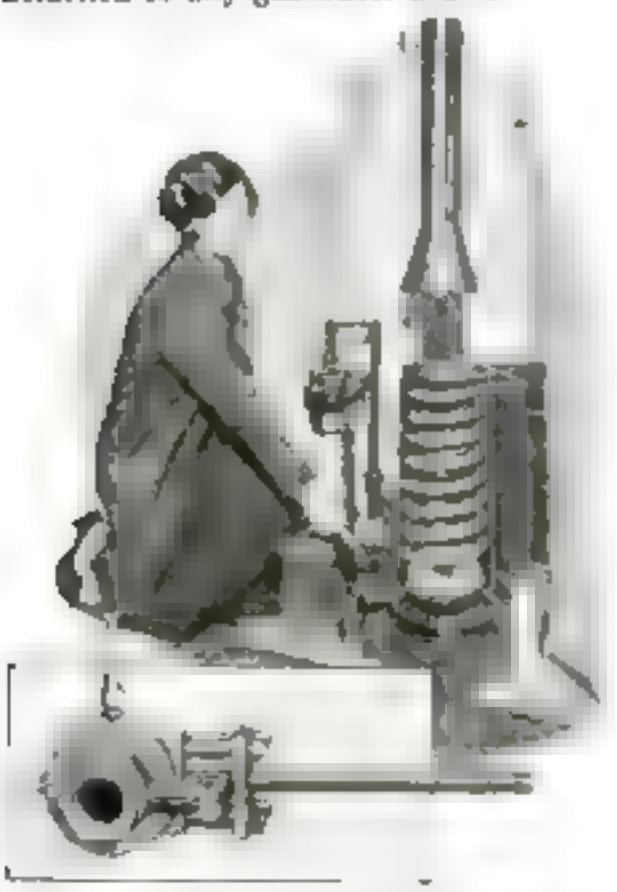
PROPELLED by a caterpillar under its hull, the strange-looking boat above moves on the Mississippi like a tank on a road. It is used to handle barges in very shallow water. At present its power is a gasoline motor, but its inventor, Carl Burr, of St. Louis, plans to replace this with a Diesel engine.

The boat moves in either direction and at the same speed. With glassed-in sides, the craft looks like a greenhouse. Most of the space in the cabin is taken up by the caterpillar housing, which runs under the craft instead of a keel. In the caterpillar cups are perforations to let part of the water through.

Safety Pilot Prevents Gas Leak in Hot Water Heater

AFTER a day, the neighbors broke in. Escaping gas met them, and in the dining room they found the whole family, father, mother and baby, dead. The pilot light to the gas heater had gone out. Such is the story one reads only too often.

A safety pilot working on a thermostatic principle, that turns off the supply of gas automatically whenever the flame goes out, prevents any such leakage. The device, which is illustrated below, may be attached to any gas water heater.



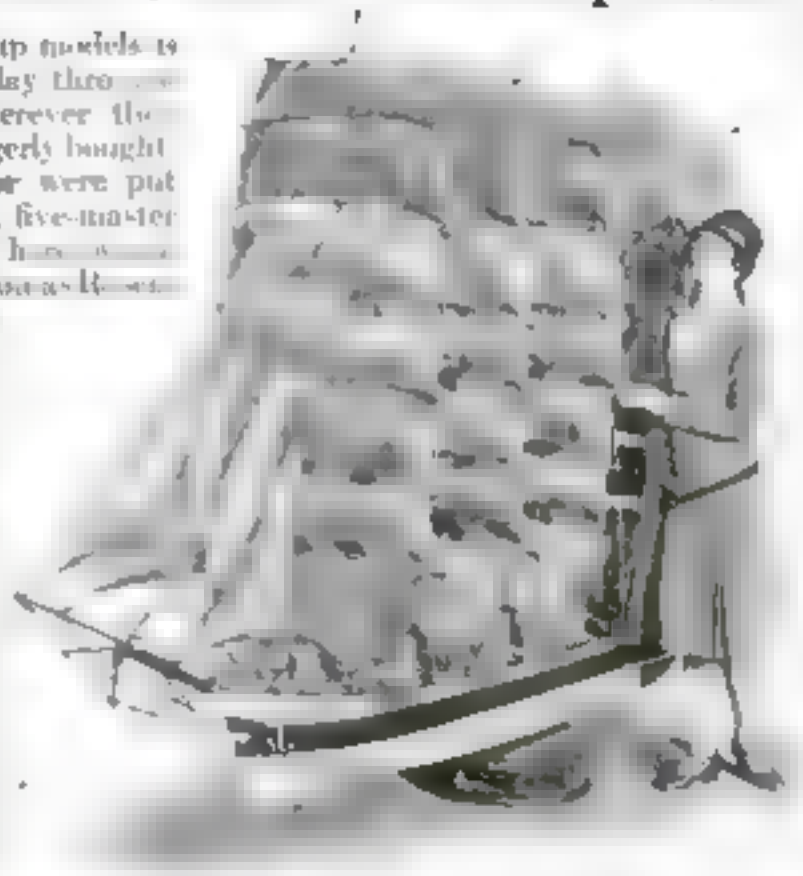
This new pilot for hot water heaters that prevents the gas from leaking, is located outside

Took Three Years to Build This Ship Model

POPULAR interest in ship models is growing stronger every day throughout this country. Wherever they are placed on sale, they are eagerly bought.

Three years' patient labor were put into the beautiful model of a five-masted full-rigged sailing ship shown here, which was completed recently by Thomas Rossi-kvist of New York City. He has named it the *Wanderer*, and it is complete in every detail even to the sheaves in the blocks and the stitching of the sails.

The marvelously perfect model drew large crowds at a recent motor boat show in New York City, where it was exhibited. The model is taller than the average person, as the illustration shows, and gives a graphic idea of the famous old five-masted ships of the days before smoke-stacks pushed graceful sails from the sea's horizon.



A perfect model of old five-masted sailing vessel

Chicago Finds Way to Speed Up Traffic Cases

CAFETERIA style in police traffic courts is being tried in Chicago, where Speed is spelled with a capital letter. Some call it the "Help Yourself Court."

In it, violators of traffic rules never even see a judge. If upon arrest they plead guilty, they appear in court thirty-six hours later and pay their fines according to a fixed scale. A card index of offenses is kept and successive fines are higher.

All like clockwork, no tiresome waiting in court or overcrowding the judge. In the picture above, an offender is shown paying his fine while a court attendant records it and gives him a receipt.

Puzzled by Swinging Baskets

SCIENTISTS have been puzzled since last October by swinging baskets brought from Borneo and set up in the Peabody Museum, Cambridge, Mass. As soon as they were in place they began their peculiar swinging, which suggested somewhat perpetual motion. Many explanations for this phenomenon were offered, but none seemed to cover it satisfactorily. Some thought there was something supernatural in the baskets, since they were originally "grave offerings." Finally, two young scientists succeeded in stopping them by putting a kink in the wire from which they hung.

British Order Big Plane to Carry 50 Soldiers

AN ALL-METAL airplane capable of carrying fifty fully equipped soldiers was ordered recently by the British air ministry. This order followed the completion of a fleet of air busses for twenty-five soldiers a short time ago for use in Mesopotamia. These airplanes are said to effect a great economy in time, money and man power in quickly transporting troops in British possessions where tribal disturbances are of frequent occurrence and speed in getting to the scene means an end to the trouble. The new fifty-seater will have tip-up seats, racks and cupboards for rifles and ammunition, and tanks for drinking water. It will carry radio equipment, and will be used as an ambulance in action.

A Help in Opening Knots

AS A substitute for fingers, these extra strong little tweezers are said to be of great help. Untying knots, hulling strawberries, pulling pin feathers, weeding small plants, and pulling beating threads are a few of the jobs for which it is especially useful—tasks usually hard on the fingers and nails.

They have a wider grip than ordinary tweezers, and hold better. The photograph shows the device in use.

A CAN of beef, part of the stores carried by the Franklin Northwest Passage Expedition of 1845, opened recently in a Liverpool bacteriological laboratory to determine whether the spoiling of the food supplies caused the failure of that venture, was found to be in perfect condition.

German Railroad Cars Fumigated in Huge Tank

Above, a passenger coach being run into this novel disinfecting tank at Potsdam, Germany. Right, the interior of the tank, showing the somewhat intricate arrangement of the gas pipes

Two huge doors close the disinfecting tank and make it practically air tight. Above, one of them is being closed after the car has been run in

INSECTS and germs haven't a chance in this unique disinfecting tank in Potsdam, Germany, where a whole car is fumigated at one time. The tank is made of sheet metal, and is air-tight when the huge doors at both ends are closed.

After traveling 31,000 miles, every express train must come to this station for fumigation. All the upholstery in the cars is taken up and time given for the gas to penetrate every crevice. Then the cars are washed thoroughly, so that when the car leaves the station it is as sanitary as the day it left the factory.

The photograph at the left shows a car going into the gas house; in the center, the interior of the tank showing arrangement of gas pipes; while the picture at the right shows the great door being closed, preparatory to filling the tank with gas.

This stand keeps a Ford transmission from slipping and falling while adjustments and repairs are being made on it. Below are shown the three attachments used with it

A Transmission Repair Stand

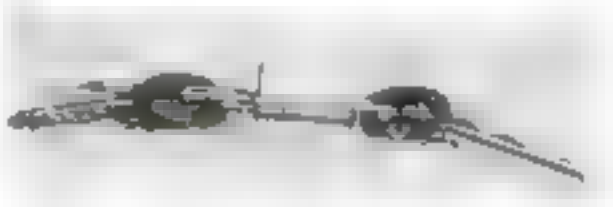
TO HOLD a Ford flywheel transmission at a convenient height while overhauling it, and to keep it from slipping and falling, the special iron stand above has been devised to hold the parts rigidly so that the work can be done quickly.

Two attachments are provided to hold the flywheel and transmission during repairs. With attachments removed, the drums of the flywheel transmission assembly slip into the head of the stand where they are held for quick replacement of starting gear or adjustment of magnets. A third attachment is used for work on each side of the differential.

Smokeless Coke Developed from Illinois Coal

A NEW type of coke that is said to be smokeless and especially adapted to household purposes has been recently developed at the University of Illinois under the direction of Samuel Wilson Parr, professor of chemistry, who has been called America's greatest expert in the chemistry of coal.

This smokeless coke has been obtained by an entirely new departure in the coke and gas making process. Instead of the high temperatures hitherto employed, low temperatures are used. The gas made by this process is said to be of high commercial value. This new method has made it possible for the first time to use the coal mined in the Illinois fields for the production of coke.



Name Plate Locks Key Ring

A MEANS for identification of lost keys other than by their numbers is provided by this new key ring, shown above. The two wings which form a name plate, when closed, hide the owner's name inside and in addition lock the device securely, so that the ring cannot open of itself and the keys come off.

Since there are two rings, one at either end of the name plate, the key in your collection you use most can be separated from the others so that you can find it with little loss of time.

Compressed Air Locomotives for Mines

IN COAL mines where there is danger of fire damp, or in tunnels and large buildings where there is danger of explosion, this new type of locomotive, right, run by compressed air is being introduced. With no sparks flying, there is no danger of ignition. The compressed air is contained in four cylinders carried on the "engine." The photograph shows one of these locomotives in a mine in Germany

Type of compressed air locomotive used in German mines

Pump House Rises and Sinks with River

The largest flexible joints in the world make possible the rising and falling of this pump house on the Mississippi, owned by a large Illinois oil refinery, as the water advances and ebbs

TO INSURE its water supply of 18,000,000 gallons a day, an Illinois oil refinery on the Mississippi recently installed a floating pump equipped with remarkable flexible joints. The two huge joints in the pipe are said to be the largest of the kind in the world. Built on several pontoons, the pump house now can rise and fall according to the stage of the water, which varies greatly from season to season. Two eighteen-inch, double suction centrifugal pumps are used.

A New Building Material

AERATED concrete containing millions of small, air-filled unconnected cavities, is a new building material, originated by three Danish inventors, which is said to have been used with excellent results recently. It consists of a thin concrete mass which, before it hardens, is violently stirred to a foamy consistency. After the mass has become hard, it is like pumice, full of small air bubbles. It is said to be a good heat insulator.

How Much Do YOU Know About Science?

YOU may think you know all you need to know about your world, but one of the most fascinating aspects of science is the new light it throws on everyday life on the familiar objects about us. How many of the following ordinary questions, for example, can you answer? To find out if you were right, turn to page 109.

1. Why are thunder storms commoner in summer than in winter?
2. What causes color blindness?
3. How much energy does the earth receive from the sun?
4. Why do we feel cooler when riding in an automobile than when sitting still, though the air itself is no cooler?
5. Does gravity affect birds while they are flying?
6. How do plants get food materials from the soil?
7. Are there any places in which it never rains?
8. How are stars used to set clocks?
9. How much blood is there in the human body?
10. Is there a sea serpent?
11. What is the filament of an electric lamp made of?
12. Why does yeast make bread rise?

Huge Iron Losses by Rust

THE West Scotland Iron and Steel Institute recently collected statistics of the annual production of iron in all parts of the world since 1890, to ascertain the corresponding annual losses by rust during the same period.

The total annual iron production reached its peak in 1913, and was about eighty million tons. In the same year the quantity of iron destroyed by rust was not less than twenty six million tons, almost one third of the year's production.

The total production of iron during the period from 1890 to the end of 1923 was approximately 1706 million tons, while during the same period fully 718 million tons were destroyed by rust.

All You Need to Shine Shoes

YOUR shoe brush and polish will always be together if you use the handy device above. The polish is concealed inside the brush. Pulling the handle apart removes the lid of the polish, closing the brush puts the top on again. A dauber is in the handle, also.

Slot-Machine Lunching Easy As Mailing a Letter

FOR speed in delivering quick lunches, the new automatic server below carries off the prize. All you need do is put in your money, and out comes a sandwich, piece of pie or cake. The foods are

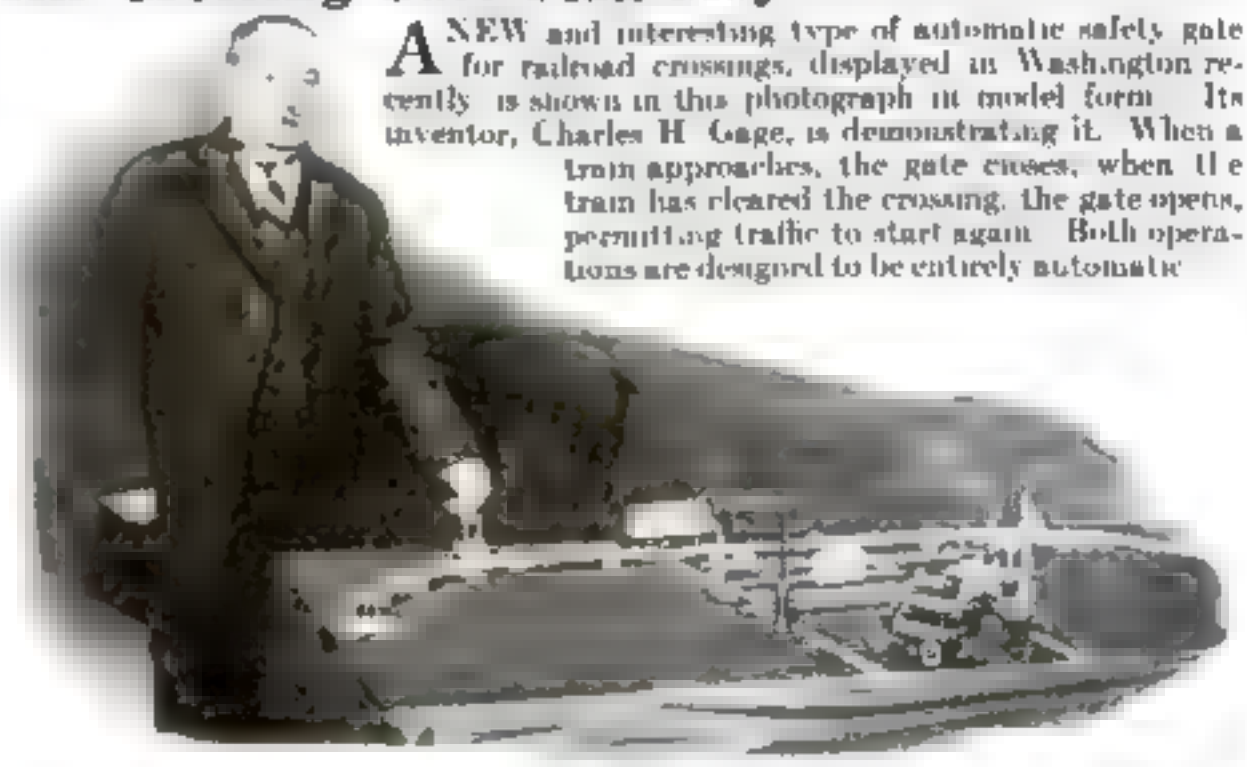
This quick lunch machine provides a new service in many large stores and factories

in cartons, and each piece sells for prices plainly marked. The machine has four magazines which hold eight cartons apiece.

For factories, shops and large stores not having lunch rooms this server is especially useful according to the maker.

His Crossing-Gate Plan May Save Your Life

A NEW and interesting type of automatic safety gate for railroad crossings, displayed in Washington recently, is shown in this photograph in model form. Its inventor, Charles H. Gage, is demonstrating it. When a train approaches, the gate closes, when the train has cleared the crossing, the gate opens, permitting traffic to start again. Both operations are designed to be entirely automatic.



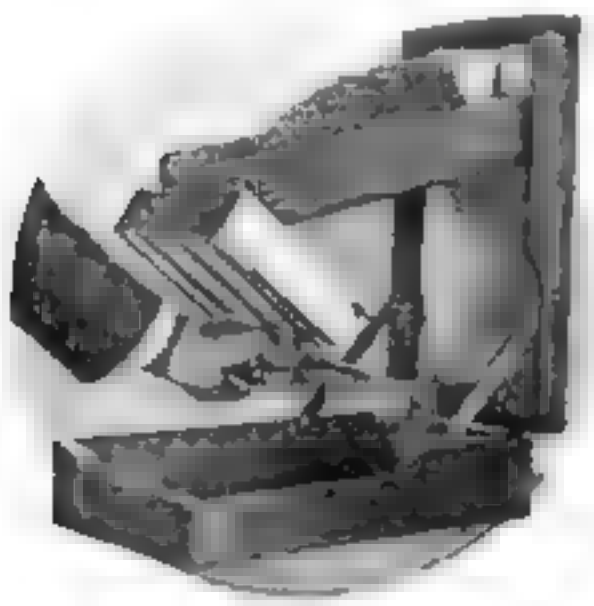
Charles H. Gage showing how railroad gates can close automatically at approach of train

A Thimble That Cuts Threads

SAVING teeth, temper and time, the little steel hook on this thimble cuts threads in a jiffy. It is actually a part of the thimble, and is worn on the back of the finger over the finger nail.

Where Some Used Nails Go

LARGE quantities of mixed nails ordinarily wasted in a building job are now sorted and salvaged by means of the small portable device shown below. The nails are picked up from the ground and



The nails slide down into runways that sort them automatically according to size

thrown, regardless of size, into a bin from which they are shaken into inclined troughs. These direct them, points downward, into runways of different sizes. The runways sort the nails automatically the larger sizes remaining in the grooves while smaller ones fall into a box below

PHOTOGRAPHY without plates or films is possible, it is claimed, with a new invention of a South African chemist. Pictures are taken directly on sensitized paper.

Auto Built to Run on Railroad Tracks

Because it can make eighty miles an hour and gets under way quicker than a locomotive this strange track riding auto is frequently called upon in railroad emergencies

FOR rushing doctors and nurses to the scene of trouble, and for inspection trips of various kinds, the Southern Railroad Company has installed on its lines the speedy railroad sedan shown above. Eighty miles an hour over level track is its record, and it gets under way much quicker than a locomotive. The axles of the car are stationary, and power is transmitted by special gears. A rheostat switch regulates its speed, and it will operate all block signal systems. Flanged wheels and a crowned tire suggest its close relationship to a locomotive.

Speeding Up Bricklaying

TWO remarkable advances in bricklaying and plastering in connection with home building have been made recently according to Charles R. Taylor, of the West Side Y M C A trade schools, New York City. The first is an electric bricklaying machine, that lays bricks at a rate far greater than that of a mason under ordinary conditions. The other is an improved method of plastering, by which six men can put on 250 square yards of plaster in less than an hour. A good plasterer, with a helper, can ordinarily put on about fifty square yards a day.

Macready's Wheel Is Fastest

THE fastest revolving wheel in the world, according to estimates of experts, is the turbine wheel on the special supercharger of the airplane used by Lieutenant John Macready in his recent attempts to better the world's altitude record. It revolves at a speed almost unconceivable to the human mind, of 40 000 revolutions a minute—almost 700 a second.

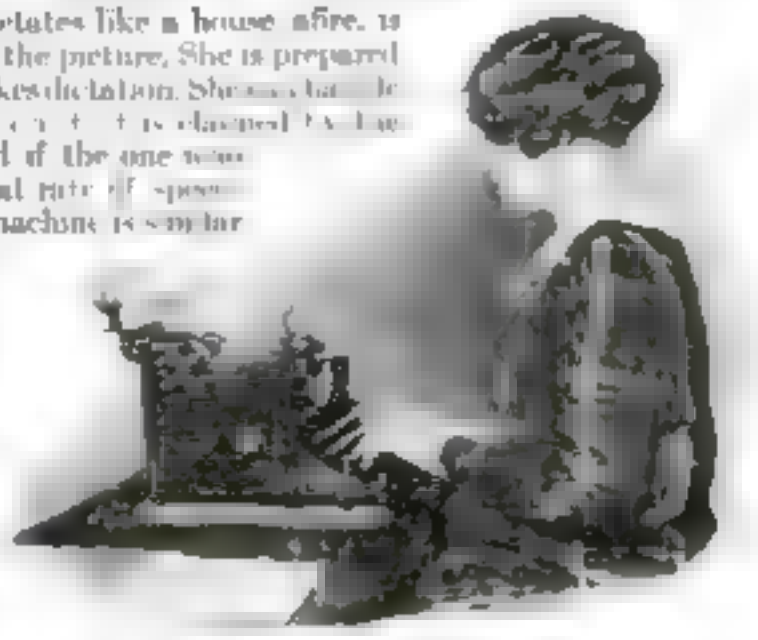
A slight idea of just how fast this is may be gained by comparing its speed with the speed limit of the average automobile crankshaft. At highest speed the automobile crankshaft reaches about 2 000 revolutions a minute, or only one twentieth the speed of this turbine wheel.

Stenographic Machine Writes Shorthand

ALL ready for the man who dictates like a house afire, is the trim little stenographer of the picture. She is prepared for him with a new machine that takes dictation. She can handle three hundred syllables a minute [illegible] claimed by the maker—if she is experienced, and if the one who is dictating to her can talk at that rate of speed.

In appearance this brand-new machine is similar to an ordinary typewriter, but it prints shorthand characters instead of letters. The paper is on a roll so that no time need be lost in changing pages. If desired, the machine can be adapted for ordinary typewriting.

The problem of the stenographic machine has been absorbing the attention of typewriter manufacturers for years. Previous models have been generally too complicated for practical use.



Taking shorthand notes at 300 syllables a minute

KNOW YOUR CAR

OVERHEATING is a common trouble in summer in spite of the fact that the average car made today is fitted with a cooling system designed to keep the motor below the boiling point even under the most adverse conditions. In fact, the average car runs much too cold for best efficiency except on the very hottest days in summer. Consequently you may rest assured that something is wrong if the radiator steams every time you travel more than thirty miles an hour or climb a medium hill.

To make sure that your motor will not overheat, watch the following points:

1. Make sure that the fan belt is not slipping. This is particularly important if the fan belt also drives the water pump.

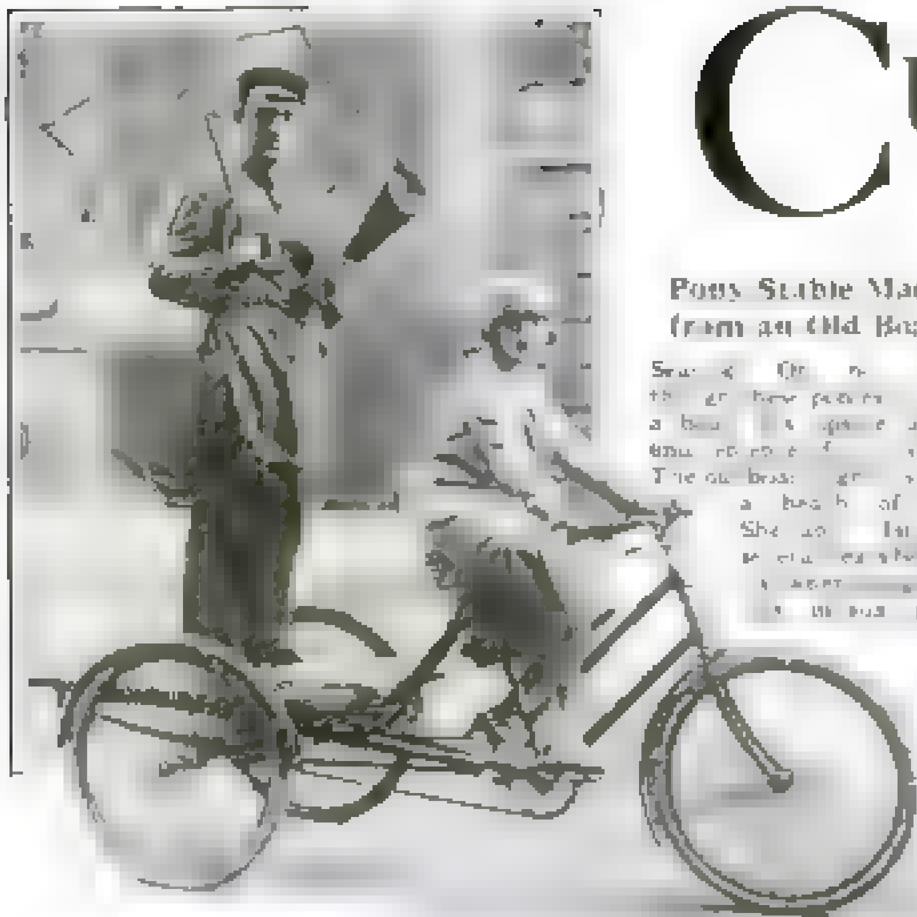
2. Keep the radiator clean. A mud encrusted radiator does not cool properly.

3. Flush out the radiator occasionally to remove rust and dirt.

4. Examine the hose connections before each long trip, as frequently the inside layer of rubber becomes separated from the fabric and obstructs the flow of the water.

5. Inspect the water level every time you take the car out.

Curious Things



Pony Stable Made from an Old Boat

[illegible]

Street Musicians Now Carry Radio Sets

H[illegible] skeleton [illegible] [illegible] [illegible] [illegible] walker [illegible] handsome new street [illegible] [illegible] program. The [illegible] [illegible] taking the place of [illegible] [illegible] in the streets of [illegible] [illegible] business [illegible] [illegible] [illegible] [illegible] [illegible] above [illegible] during dinner

Sub's First Capture a Real Whale

A [illegible] [illegible] [illegible] When [illegible] [illegible] something [illegible] Massachusetts [illegible] [illegible] whale [illegible] The [illegible] [illegible] back [illegible] and [illegible]

She Kills without Qualms

Here [illegible] woman [illegible] of bugs. M[illegible] [illegible] White Plains, N. Y. [illegible] probably the [illegible] only woman [illegible] [illegible] [illegible] She wears a gas mask while at work and has saved thousands of trees [illegible] at the risk of her own life

A New Job for Women

"Ever from [illegible] which the young ladies [illegible] [illegible] At the Pennsylvania State College of Optometry, Philadelphia, the feminine element [illegible] [illegible] [illegible] [illegible] [illegible] The [illegible] in the picture above are diagnosing patients in a clinic. They are enthusiastic about their work and once more men in a profession are looking to their laurels with apprehension

Castle of Pots and Pans

[illegible] a potter [illegible] [illegible] the surprising [illegible] [illegible] [illegible] interested visitors. [illegible] near his kilns on a hillside [illegible] made up of [illegible] of many curious shapes [illegible] [illegible] [illegible] has placed small statues

the World Over

Battleship Built in a Lamp Bulb

Amazing patience [illegible] New York [illegible]

King of Mouth Organists

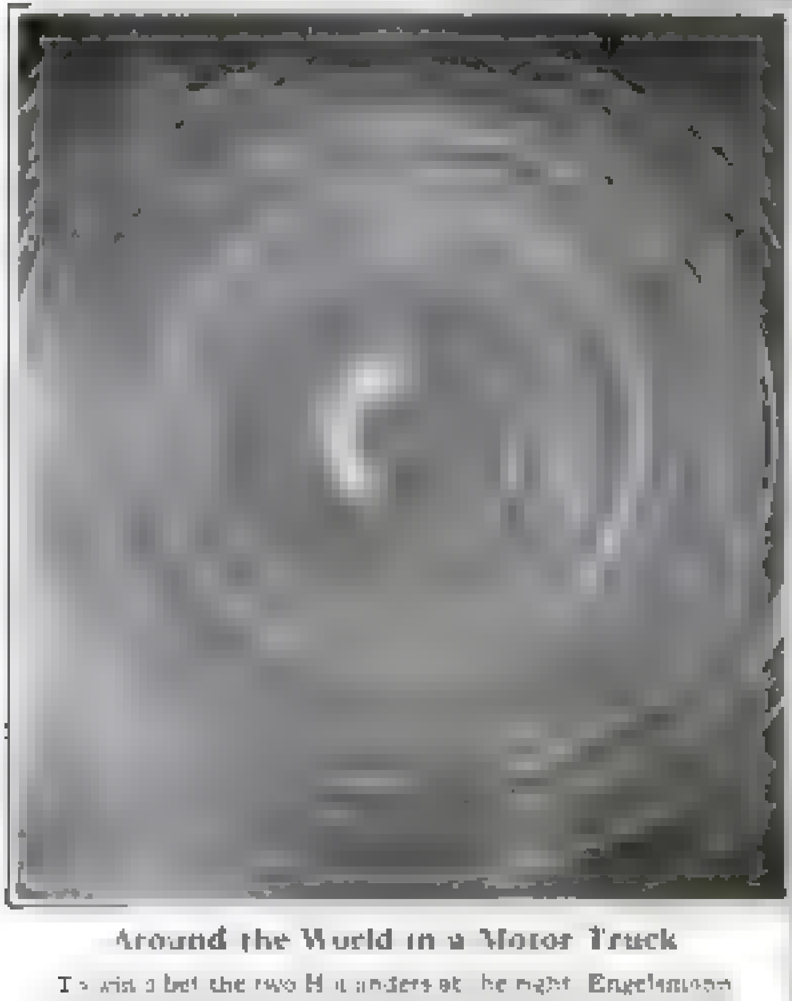
Make [illegible]

A Hot Weather Hint?

[illegible]

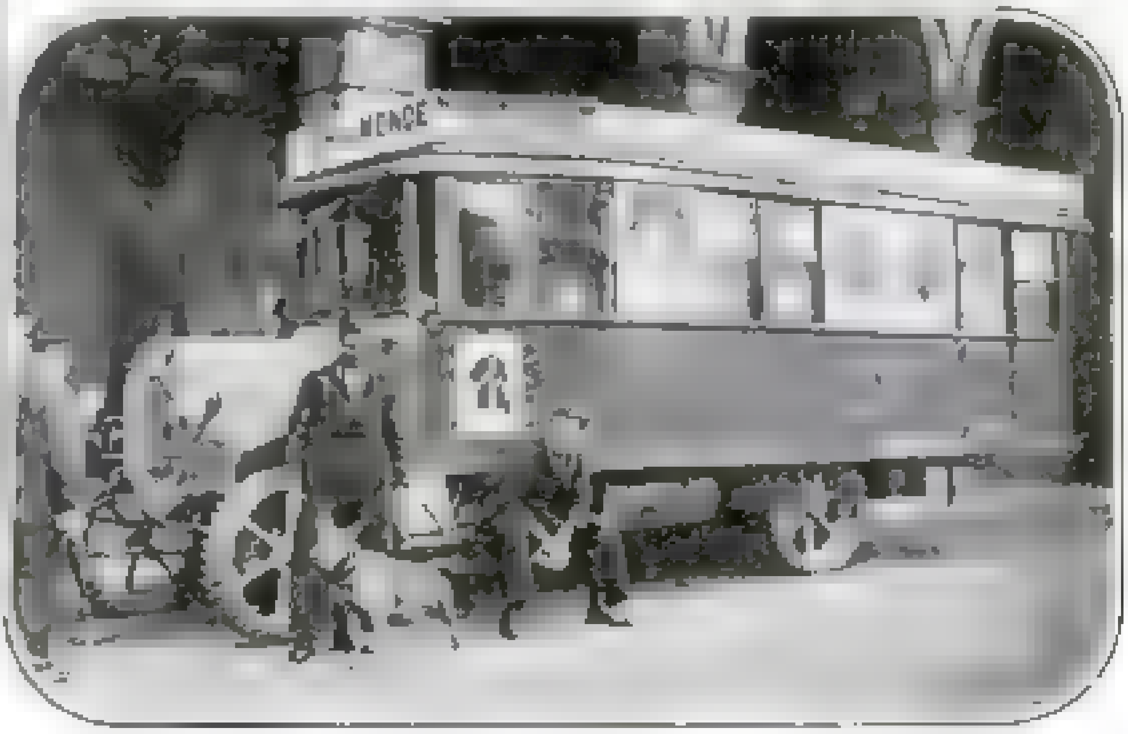
Huge Monument Looks Like Solid Bronze

[illegible]



The Whirling Stars

Proof on a photographic plate that our heavens [illegible] stars move in a circle [illegible] O. W. Morehouse, president of Drake University, exposed a plate [illegible] from dark until dawn. The [illegible] was the strange picture at the left. The paths of stars had marked the plate like grooves in a phonograph record. [illegible] the negative shows that the North Star is not exactly at the North Pole. Its path is marked by the [illegible] near the center of this remarkable photo



Around the World in a Motor Truck

To win a bet the two Hollanders at the right, Engelsman and Kumpers, started out on October 28, 1924, in a [illegible] They must be back [illegible] by 1934. So far the wanderers in their [illegible] have visited nearly every country of Europe, so we may expect to see them over here soon

Golf Right in Your Home on the World's Finest Links!

Pictures of the links on which he is "playing" appear in the long, narrow cabinet

WITH the remarkable indoor golf system shown in our picture, the player to all practical purposes is playing on an outdoor course. Though his ball brings up against a canvas curtain, every shot is measured for direction and potential distance on any well-known golf links he may select. Behind the canvas curtain is a large wire hoop covered with netting. It takes the impact of your ball striking the canvas, and transmits the force to an electrical contact. This contact starts a small motor in a cabinet containing a roll of pictures of fairway, woods, lakes and traps, each representing one hole of a golf course. An indicator slides along the picture and records the distance of the drive and the "lie" of the ball so that the player may see what kind of club to use.

Should the indicator show that the ball has landed in a sand trap, you play your next stroke from a special mat which presents trap difficulties. If a ball is sliced or hooked, it strikes a part of the canvas marked "rough." A green or white light shows if the drive was to the right or left.

Richard H. Strasser, of Newark, N. J., is the inventor of this ingenious outfit.

Slot Machine Makes Change

PEPPERMINTS, chocolates, taffy? To get the candy you like, you just drop a coin in the slot of the machine shown at the right,—any coin up to fifty cents—point an arrow to the candy you want, and the machine will drop the candy and your correct change into a pocket.

This new vending machine, exhibited recently in Chicago, attracted much interest, especially its change-making feature.

It gives you not only candy but change, too

A Double-Ended Toothbrush

WITH split handle, the two parts kept tightly together by friction, the new toothbrush shown in the illustration has a brush at each of its ends. The larger brush cleans the outer surface of the teeth, while the small one is used for cleaning inner parts. When in use, the brushes are separated so that the hand need not touch either brush, but with the novel handle arrangement you will always find them together when you want them. The larger brush is curved to fit the teeth.

The handle snaps apart, separating the brushes

Saving the Vanishing Beaver

BEAVERS can be caught alive without injuring them by means of a trap recently patented by Vernon Bailey of the United States Department of Agriculture. It is designed to catch the animals, not for their fur, but for propagation purposes, because they are vanishing rapidly.

Gun Can Shoot 7,000 Yards

SHOOTING at the rate of 300 bullets a minute with an effective range of from 4,000 to 5,000 yards, a new machine gun may be able to wipe out an entire battery crew. It is a fifty-caliber Browning with a maximum range of 7,000 yards. A newly designed bullet with beveled, streamlined base is largely responsible for the gun's increased range.

Most artillery used in the World War, having an effective range of from 4,000 to 6,000 yards, could not be reached by machine-gun firing. These will now fall well within the range of the new gun and be made ineffective unless the range of the fieldpieces, too, can be increased.

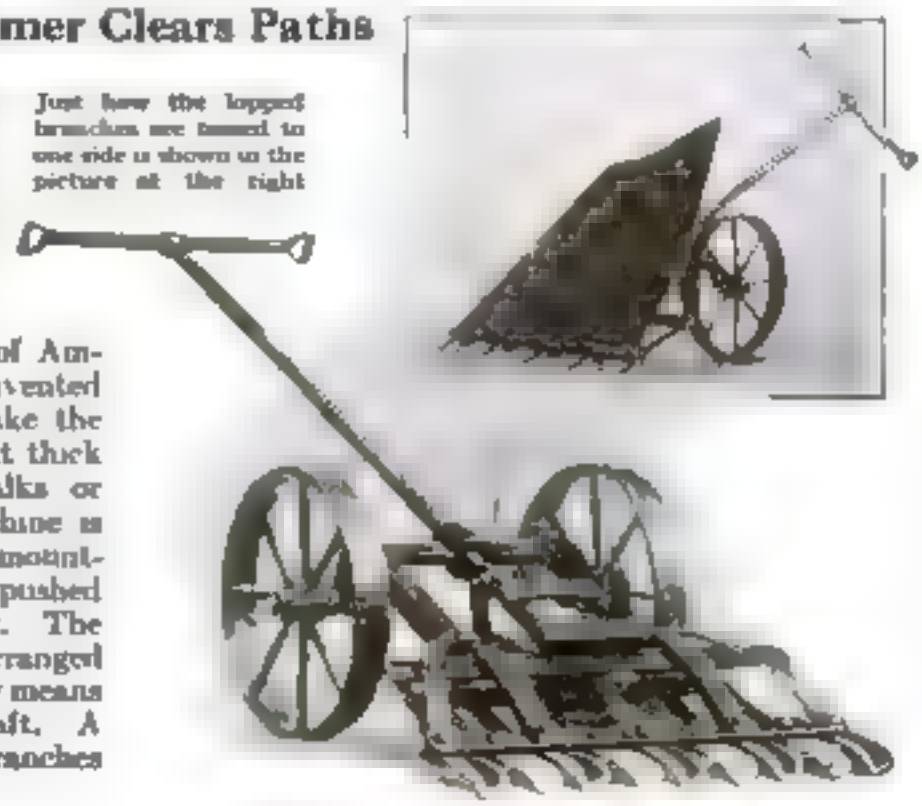
A TRANS-ATLANTIC cable laid recently between London and New York is sheathed in permalloy a new material. This cable transmits 2,000 letters a minute, ten times the rate heretofore.

New Bush Trimmer Clears Paths

NOBODY on a farm is eager to tackle the job of cutting bushes. But it must be done once a year, at least the hedges along the highway, to comply with state laws.

Kazimer Dombeck, of Amsterdam, N. Y., has invented a bush trimmer to make the work easier. It will cut thick branches, also cornstalks or sugar cane. The machine is operated by hand, and, mounted on wheels, can be pushed over the ground easily. The cutting blades are arranged in pairs and operated by means of a crossbar on a shaft. A shield throws the cut branches to one side.

Just how the lopped branches are turned to one side is shown in the picture at the right



Peter Pace, Rochester N. Y., dentist who invented a system for operating railroad gates with magnets, exhibits his ingenious model

Automatic Railway Gate Device Uses Buried Magnets

AN AUTOMATIC gate buried in the ground and drawn up by powerful magnets to close the crossing when a train appears, is the ingenious invention of Peter Pace, a dentist of Rochester, N. Y. Needing no gatekeeper, he says that it would mean a great saving to railways.

No motors are needed to operate the gate. It is placed between two tall posts that bear white and red lights and a warning bell. When no train is coming, the white lights burn and the gate is underground covered with a protector flush with the crossing. An approaching train throws a switch that controls the mechanism. Two giant magnets buried in the ground near the posts draw up the gate. The red lights appear and the gong rings. As the train passes, the wheels strike a trigger that shuts off the circuit and lets the gate down.

ABOUT 85 percent of the anthracite coal resources of America has been mined.

Boy's Rubber-Band Airplane Flies 135 Seconds

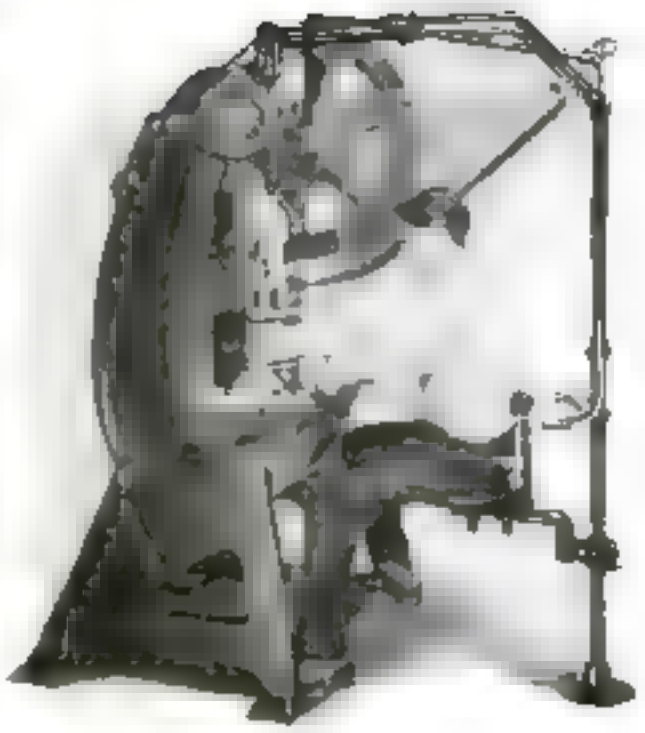
ESTABLISHING a new record for indoor flight by a miniature airplane with a rubber band supplying the power, the winning plane in a tournament held recently succeeded in staying in the air for 135 seconds, or more than two minutes. The model was built by a high school student.

In the same contest a rubber-band airplane weighing only one-eighth of an ounce and built by a fourteen-year-old boy stayed in the air for 100 seconds. The tiniest flying machine competing in the various classes was a one-tenth-ounce glider which sailed eleven seconds with no power at all.

TO PREVENT killing fish in rivers of some mining regions where acid drainage pours into streams from mines, the water is neutralized with lime, limestone or marl. This process saves many fish yearly.

A Place for Your Pipe

THIS new pipe rack keeps ashes from spilling where they aren't supposed to be spilled. It is made of polished wood, accommodates either a straight or curved stem pipe, and a package of matches.



Safety at the Punch Press

WHEN the ram of the punch press above descends, the operator's hands will be drawn back to safety. His wrists are fastened to a safety device, attached also to the ram, that pulls them back automatically. He has free use of his hands, when the ram is up, within a radius of the length of his arms.

A Glass You Can Cut and Roll

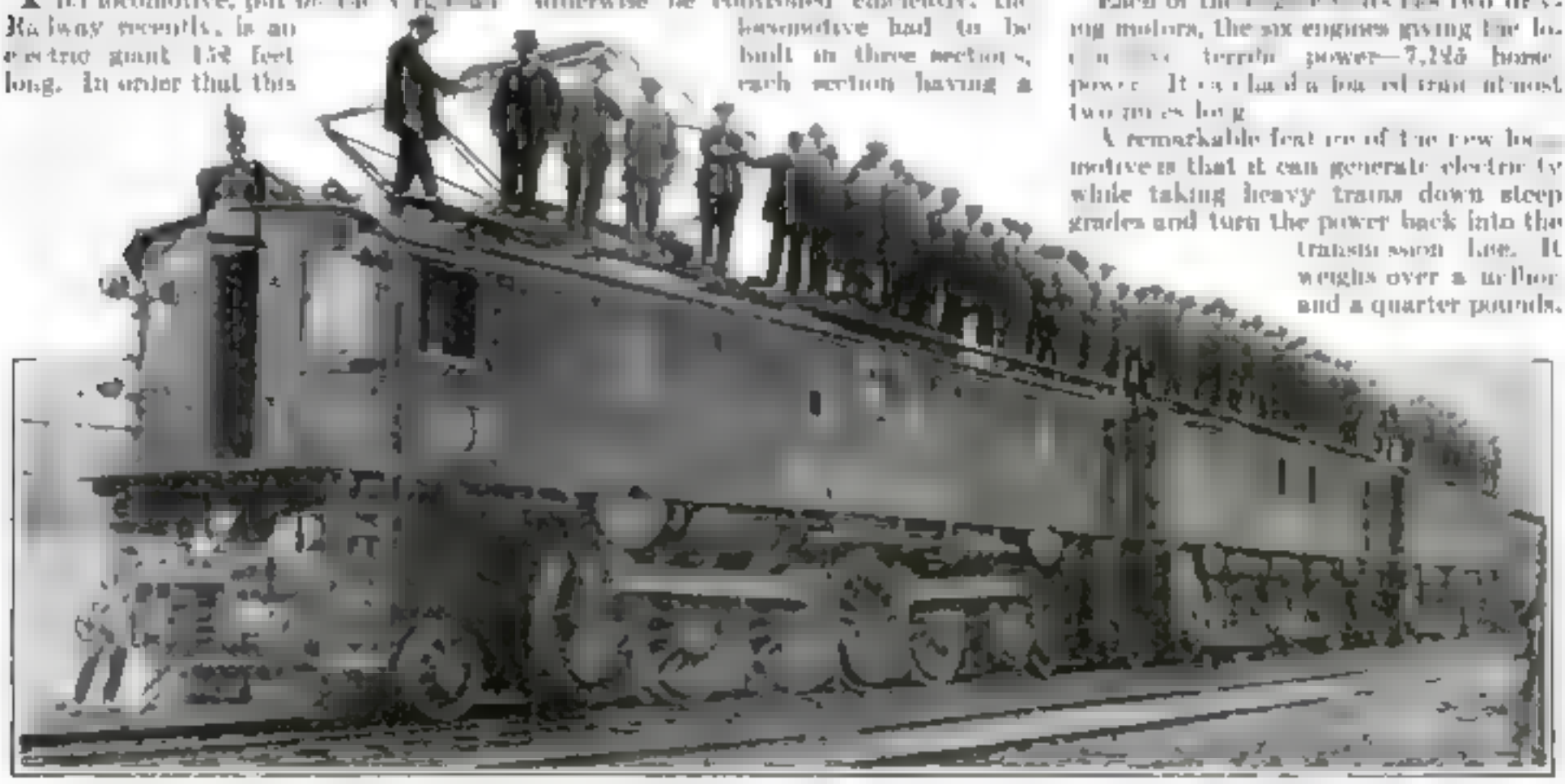
WINDOW glass that rolls up and can be cut with a shears is a unique new material recently put on the market. It will be especially useful, it is believed, for covering windows and other openings in temporary buildings such as contractors' shacks. Since it is practically unbreakable, the same "glass" can be taken from one window and put in another and used repeatedly. It is translucent, and has a base of galvanized iron mesh.

World's Biggest Locomotive Had to Be Split in Three

THE world's largest and most powerful locomotive, just built for the Virginian Railway recently, is an electric giant 152 feet long. In order that this great length could negotiate curves and otherwise be controlled efficiently, the locomotive had to be built in three sections, each section having a separate electric power and installation.

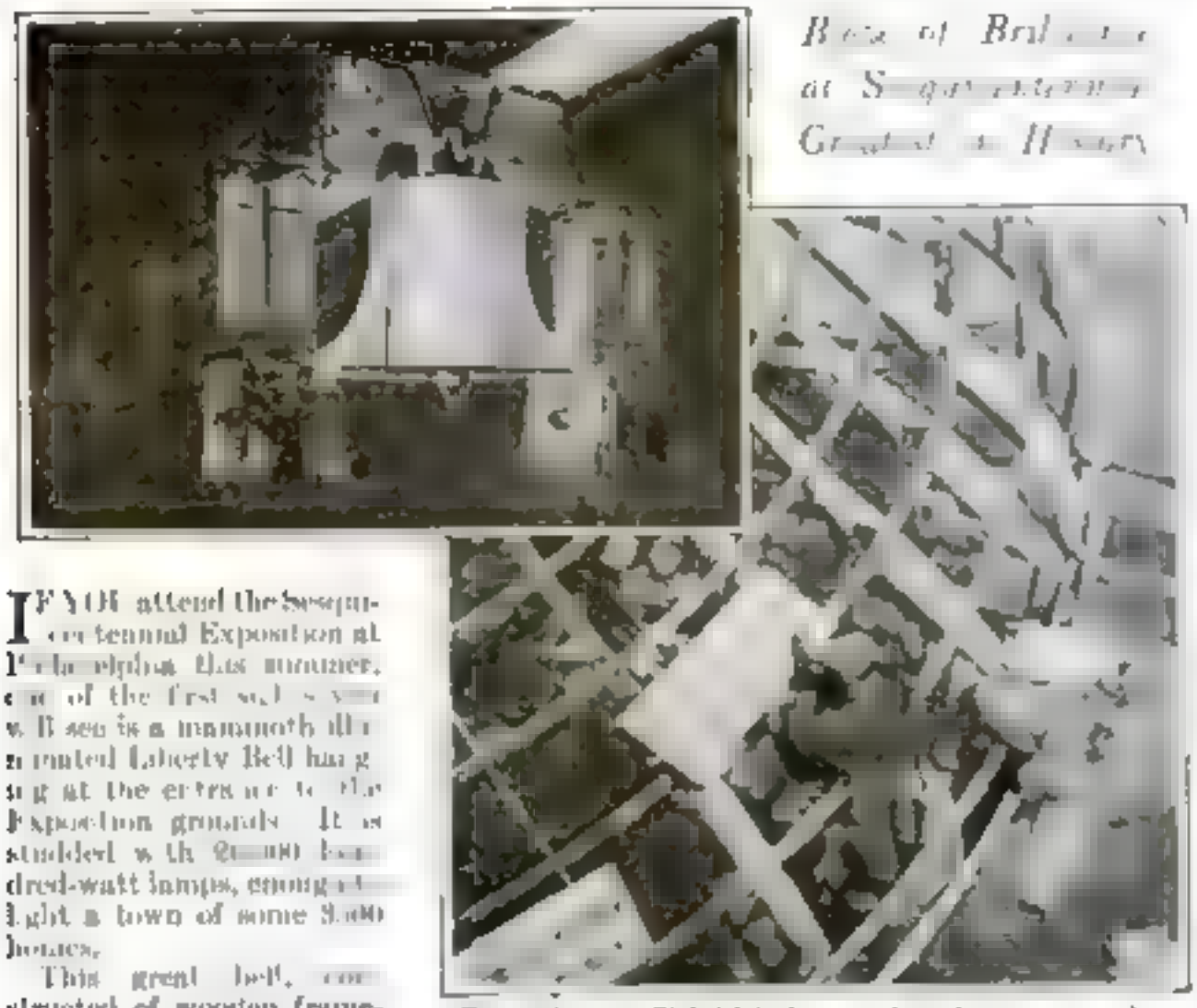
Each of the [illegible] has two driving motors, the six engines giving the locomotive terrific power—7,248 horsepower. It can haul a load of [illegible] most two miles long.

A remarkable feat of the new locomotive is that it can generate electricity while taking heavy trains down steep grades and turn the power back into the transmission line. It weighs over a million and a quarter pounds.



To enable it to take curves, this gigantic locomotive of the Virginian Railway had to be built in three sections, each with its separate power unit. The driving wheels are more than five feet in diameter and the husky men working in and about the colossal engine look like pigmies

26,000 Lights Stud Giant Bell

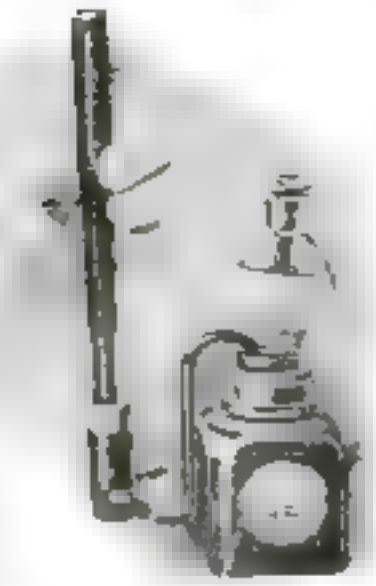


Every visitor to Philadelphia's great show this summer probably will pass under the mammoth Liberty Bell hung over the entrance. It is part of the greatest concentration of light in the world's history. In the lower illustration electricians are shown stringing up the lights that now completely cover the bell

IF YOU attend the Sesquicentennial Exposition at Philadelphia this summer, one of the first sights you will see is a mammoth illuminated Liberty Bell hanging at the entrance to the Exposition grounds. It is studded with 26,000 hundred-watt lamps, enough to light a town of some 3,000 houses.

This great bell, constructed of wooden framework covered with sheet metal, forms part of a magnificent electrical display which is said to represent the greatest concentration of light in the world's history. It is about fifty feet high, weighs forty-two tons, and is suspended from supporting towers seventy feet high. It stands as a symbol not only of the one hundred and fiftieth anniversary of American independence, but also of the marvelous electrical age encompassed within the last half century. At the Centennial Exposition fifty years ago, gas lighting fixtures were feature displays, and the incandescent electric light was still to be born.

Other remarkable lighting effects at the Sesquicentennial are supplied by a battery of twenty-six superpower searchlights with a total of more than eleven million candlepower. Their beams are visible more than a hundred miles away on clear nights.



Any four-ounce ink bottle can be fitted with this fountain pen filler

Pen Filler Fits Ink Bottles

WITH fountain pens in such common use, many persons use ink bottles now only to fill their pens. A new device, fitting on the bottle, makes the filling operation easy and at the same time keeps the ink clean and prevents its evaporation.

When a plunger is pressed, a small glass cup at the side of the bottle is filled with ink, as shown above. When the plunger is released, after the pen is filled, what ink remains goes back into the bottle automatically. The plunger can be locked in position. The device is designed to fit any four-ounce ink bottle.

Handy Churn Fastens to Wall

FASTENED to the wall, this electric butter churning machine, invented by W. J. West, of El Paso, Ark., is out of the way when not in use. The motor is said to use about a tenth of the current required to heat an electric iron.

This churn can be connected in a few seconds

Besides churning butter, the machine may be used for pumping water from a well, pumping up automobile tires or operating an ice cream freezer. It makes any length of stroke required, and the stroke may be raised or lowered without moving the machine.

Repeating Detonator Warns Trains in Fogs

HEAVY fogs blotting out ordinary light signals have caused many severe railroad accidents, and especially in England, where fogs are frequent, new inventions are constantly being made to give engineers warning of danger ahead.

One of these is the new automatic fog warner illustrated at the right. When a lever is pulled down, a detonator is laid on the track. When this is exploded by a train passing over it, the lever flops back and another detonator is placed on the track automatically, to warn the next train.

Foreman setting the detonator which repeats its fog warning for every train passing over it

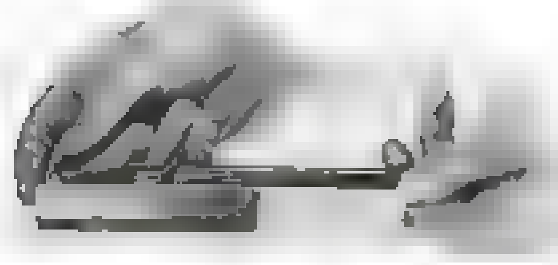
What Invention Is Most Needed?

SOME time ago POPULAR SCIENCE MONTHLY *began the creation of one of the most interesting books in America, to be entitled "What's Wanted." Its contributors are the readers of this magazine, and its contents consist of their suggestions for needed inventions. What invention or inventions do YOU think are most needed? Mail in your suggestion. We will be glad to enter it with the many other ideas contained in this wonderful book.*

Trick Photographs Aid Building

SO THAT prospective builders may see for themselves just how a proposed building will look when erected in its future surroundings, a method of showing it in photographs has been devised.

A picture is made of the site from a distance, showing the buildings in the neighborhood. A photograph is then taken of a cardboard model of the proposed building at the correct angle to fit in the picture of the site, and enlarged or reduced to fit the scale of the first photograph. From the composite of the two photographs, a new negative is made and a final print made from this.



Pocket Comb Has Sliding Cover

BOBBED heads require frequent combing, especially after wearing a small hat. This comb has a sliding cover that acts as a handle, the small hinge on top holding it to the comb. The covering keeps the comb clean and saves pockets.

Ingenious Inside Pipe Wrench

FROM an inventor in Alaska, Fred E. Bowman, of Anchorage, comes a new inside pipe wrench and nipple chuck. The picture shows it being used to remove a broken piece of boiler pipe.

The wrench can be used on three sizes of pipe by inserting the jaw corresponding to the size of pipe. Since the outside radius of the jaw corresponds to the inside radius of the pipe, it does not distort the shape of close nipples or nickeled tubing.

Removing a broken piece of boiler pipe

It can be used on close nipples, radiator valve spuds, O.D. tubing and any other round objects that an ordinary pipe wrench would crush, and also in some types of plumbing repair work.

"A Shining Palace in the Sky"

Skyscraper Illumination [illegible] [illegible] L[illegible]

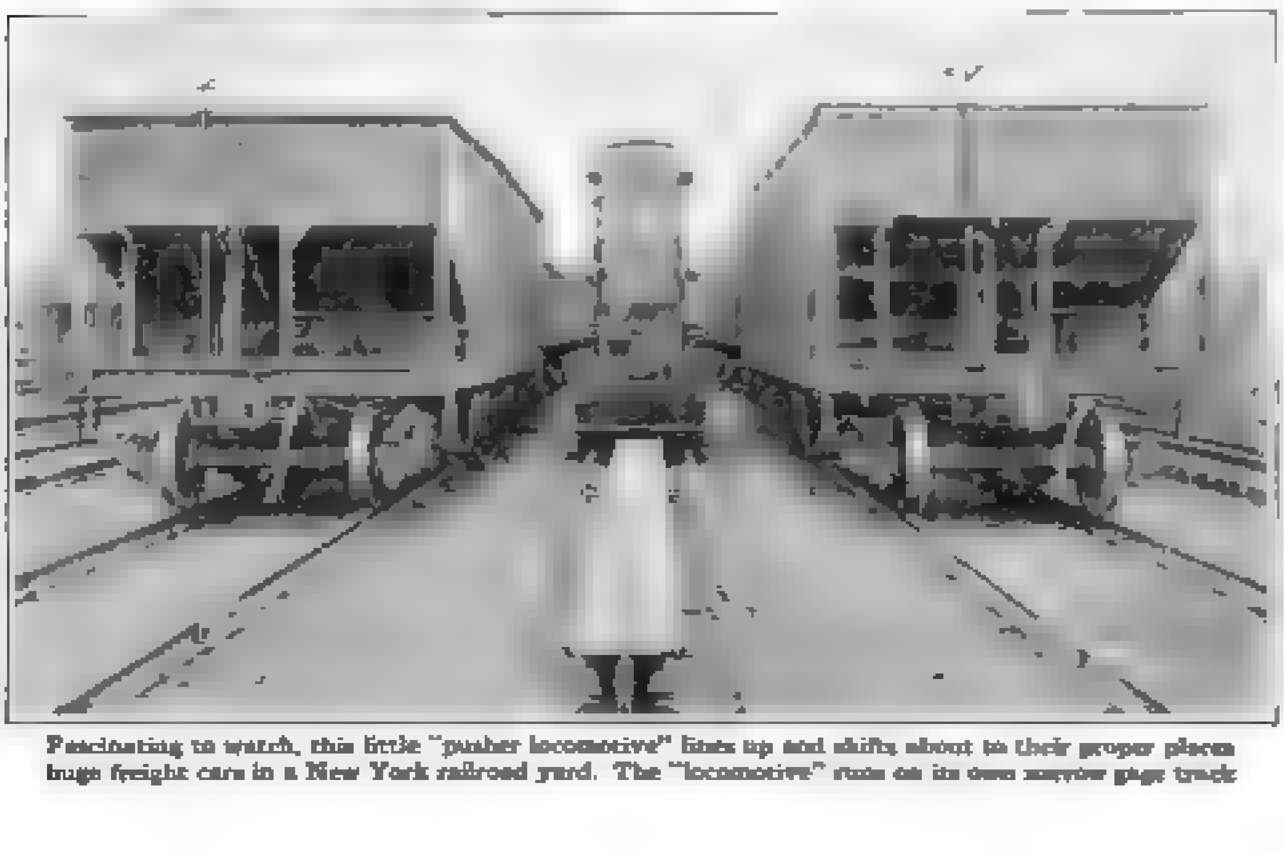
One of the [illegible] [illegible] [illegible] floodlighting [illegible] San Francisco skyscraper [illegible] effect shown

DAZZLINGLY white against the night sky, the upper part of this new skyscraper in San Francisco looks like a shining palace set high on a mountain crag. In floodlighting the Pacific Telephone and Telegraph Company's new twenty-six story building, one of the finest structures on the Pacific coast, batteries of thousands of powerful lights are so placed that they send beams up against the white masonry, which almost totally reflects the rays. The tower of the building, it is said, may be seen for miles around when illuminated.

"Pusher" Shifts Cars About in Freight Yards

FOR quick and convenient handling of freight cars in railroad yards, a new type of locomotive called a "pusher locomotive" has been put in service. It lines cars up on a track and pushes whole strings of them about, replacing the large locomotives ordinarily used.

Running on its own narrow gage track between two strings of freight cars, this small electric locomotive has arms extending on both sides. These push against the buffers of cars on adjacent tracks. One arm may move a string of twenty-five empty cars at a time.



Fascinating to watch, this little "pusher locomotive" lines up and shifts about to their proper places huge freight cars in a New York railroad yard. The "locomotive" runs on its own narrow gage track

New York Now Building "Waterproof" Skyscrapers

SKYSCRAPERS that don't leak, as most of them have done up to the present, and let water seepage damage walls and furniture, are now being built in New York City by L. L. Melius, builder.

Mr. Melius' method is to run a narrow "raincoat" of waterproof felt around the building at every story under the thin layer of brick covering the intersections of the steel skeleton. It is through these bricks that the water usually soaks.

"We decided we couldn't prevent water coming through that thin screen of brickwork until someone invented waterproof bricks and mortar," says Mr. Melius, "but we could drain the water all out again before it got to the inner plaster walls. We evolved, therefore, the raincoat idea. Now, when the water soaks through the bricks, it runs along that felt just as if it were a gutter, and out again into the open air and finally harmlessly down the outer wall."

The last six or seven office buildings to go up in New York are being made leak-proof according to this new plan.

May Regroup Typewriter Keys

MORE speed on the typewriter would be obtainable if the letters on the keyboard were arranged differently, according to psychologists in France. They have had typewriters hooked up to smoked drums, and have studied the smoked paper to determine the intervals of time elapsing between hitting successive keys.

On the present standard keyboard, letters are arranged so that those most used are within the easiest reach. Other things, though, the French investigators are finding, are even more important. For example, least time is lost, they say, when two successive letters are struck by alternate hands. So they suggest putting half of the most used letters on the left side, and the other half on the right.

Newest Devices to

Washing Machine Fits in Sink

So small and light that it can be picked up in one hand and set in the sink or bathtub, the aluminum washing machine above runs by water power from the faucet. It is intended especially for washing out delicate lingerie baby things, silk stockings, handkerchiefs and dainty laces

Rubber Broom Bumper Saves the Furniture

Even the most careful worker, sweeping with an ordinary broom, occasionally scratches and mars fine furniture. A new rubber bumper to prevent this is shown at the right. It is easily and quickly put in place over the "bumpy" part of the broom, and it sticks snugly in position

Opens Cap Bottles

Mothers who are busy these days putting up lunches for young picnickers may surprise them by slipping on any cap bottle the little ring shaped attachment shown below. Pulling the ring opens the bottle and releases a small tin fork

Protects the Hands

Women using the ingenious dishcloth holder above need not fear "those dishwater hands," according to its maker. The cloth is held at the end of a handle by wire fingers

Can Hide in a Hat Box

This little electric washing machine for special laundering right weighs only twenty two pounds. When not in use it may be kept on a shelf, for the lid can then be turned upside down and fitted into it

Even Dust Is Handled Scientifically

Where are dust mops shaken in your house? At the window where the dirt blows in again? A novel dust receiver, in which the mop handle is shaken easily up and down in a slot is shown above. It also has a large dust drawer at the bottom in which to empty your vacuum cleaner

Service Panel for the Milkman

Notes for the milkman can be left safely outside overnight in a slot in the handy milk bottle holder shown below. It receives the bottles, too, keeping them safe from prowling cats and dogs. The ticket slot can be seen at the left of the panel

Safety Gas Burner Igniter

Automatic relighting of the gas if it blows out is claimed for this new gas burner igniter. Turning the gas cock, even accidentally, lights the burner, preventing any danger from escaping gas

Easily-Opened Ironing Table

Without any bending or complicated balancing, you can open or close the ironing table above with one movement. It has no wires or springs, is very compact, and the manufacturers say it is so rigid that you can sit upon the free end of it without tipping

Lighten Housework

Rims for Pitcher Bottoms

Rubber rims slipped on the bottoms of jugs or buckets keep them from scratching surfaces or marking carpets on which they are set. The rims shown in the picture below come in various sizes. They slip on easily according to the maker, and stay snugly in place

Electric Ironer with Handy Control

Unusually easy control of this new electric ironer is said to be provided by the guide board across the front under the operator's hands in the picture The slightest pressure on any point of the board will move the shoe to or away from the ironing roll

Prevents Charring of Pot Handle

To prevent charring of the handles of coffee pots, there is a small metal guard that can be slipped easily in place on the bottom of the handle. As shown above, it will not get in the way of your hand

Self-Shaking Corn Popper

All the shaking necessary for corn popping is done by the stirrer attached to the lid of the corn popper shown at the left. When the lid is down, the knob in the top is turned briskly. The stirrer is thus kept constantly moving

Ironing Board in a Door

Built in a door, the ironing board shown below is out of the way, yet needs no special cabinet in the wall. The carpenter can install it in your house in any ordinary doorway. Closed up, the door seems merely to have an unusual arrangement of panels

To Rid Kitchen of Cooking Odors

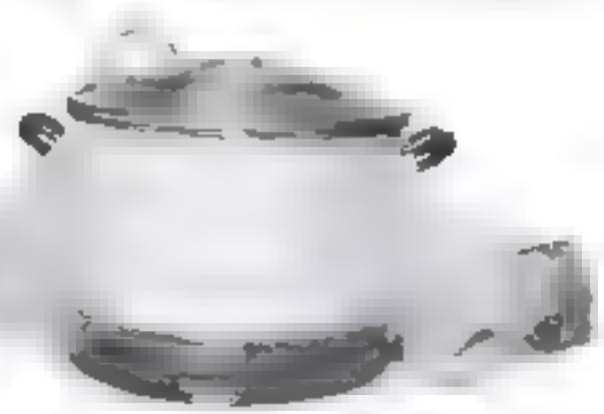
Even the odor of cooking cabbage is said to be killed if the novel vaseline room deodorizer shown above is hung on the kitchen wall. The device is made of clay and acts on the principle of a sponge. A perfumed liquid is poured into it and is soaked up, the air of the room, it is said, being made delightfully fresh and clean in the process

French Fryer with Basket Drainer

A new kind of French fryer shown above, has a wire basket which is immersed in the fat during the frying. The fat is then drained by lifting the basket out and supporting it in the manner shown. The frying food is thus kept at the maximum heat while it is being drained

Steam-Iron Saves Sprinkling

Steaming clothes while it presses them, this new electric iron (left) is intended to do away with the job of sprinkling. From a reservoir in the insulated handle, water drops to the base, coming out as steam through many small holes and just moistening the fabric



Cooker-Oven Needs No Basting

Equipped with a special bottom in which it fits, the enamel cooker above can be used also as an oven. Between the bottom of the cooker and the special base is a layer of asbestos. No basting is necessary according to the maker. To brown the food, the vent in the lid is opened a few minutes

Hints for Radio Beginners

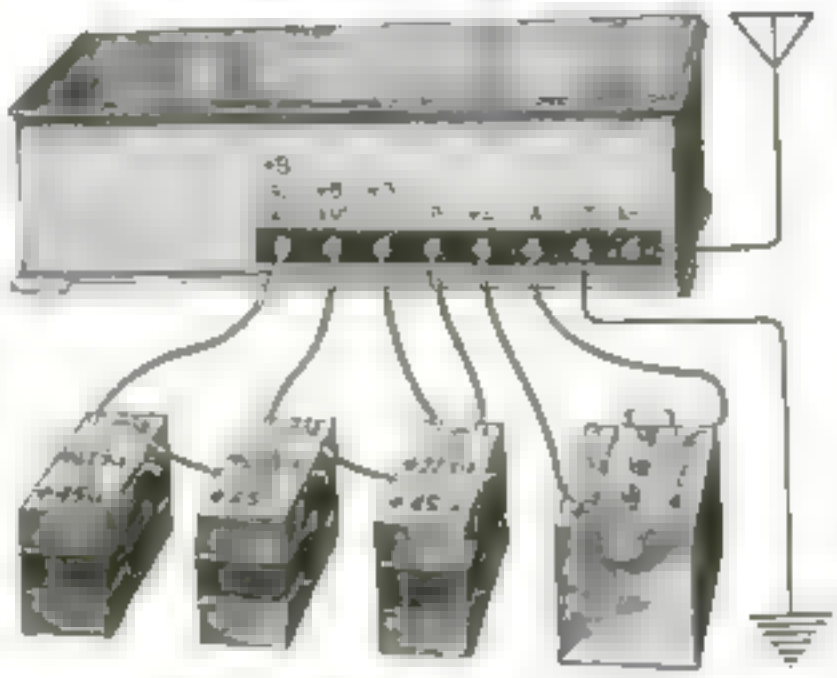
How to Connect Up B-Batteries

Other Pointers on Dials, Loudspeakers, and Radio Symbols

CONNECTING up the B-batteries is often puzzling to the radio beginner because so many wires must be run from the binding posts of the receiver to the B-battery. At the back of the average multi-tube set there are anywhere from seven to ten or more binding posts and after you have connected on the antenna, the ground and the A-battery where they belong, the rest of the binding posts must be connected to the B-batteries. Most amateur and factory built sets are now designed with the C-battery connected inside the cabinet in order to cut down the length of the grid leads, and so in most cases you will not have to consider the C battery as far as the rear binding posts are concerned.

The most common arrangement is three B-battery binding posts marked respectively "—B ", "+B DET" and "+B AMP", but there may be other binding posts marked "+B 67½ ", "+B 135 " and so forth. In most sets used today, the B-battery requirements really call for a sufficient number of cells connected in series to give the maximum voltage needed to operate the last stage of audio amplification, and the other voltages are obtained by branch wires tapped in toward the plus end of the battery.

With a standard type of set, therefore, the first job is to connect all the blocks of B-batteries in series, as shown in the illustration. Then you connect the plus wires at the points where the voltages add up to the specified amount.



Voltages Should Add Up Correctly

Connecting up the B-batteries is a simple matter if you remember first to wire them in series, which means in a row with a plus terminal to a minus terminal at every joint, and then, after this has been completed, add up the desired voltages from the minus end

A B C's of Radio

MOST diagrams that show how to hook up the antenna, ground and lightning arrester to the radio receiver are based on ideal conditions, where the radio set can be placed right beside the window through which the antenna lead-in is brought into the house and a cold water pipe always seems to be convenient for the ground connection.

The actual conditions surrounding most radio installations, however, are not so simple. Often the window through which the antenna lead-in must come is separated by two or three rooms from the only place where the set can be installed. And the radio beginner usually finds that the nearest cold water pipe is on the other side of the house.

Under these conditions, you must be especially careful to run the antenna lead-in wire as directly as possible, and to avoid running it close to the ground wire or metal objects such as radiators, gas or electric fixtures or anything else that might by-pass the radio-frequency current.

Proper Loudspeaker Setting

MANY types of loudspeakers are provided with an adjustment to regulate the space between the magnet and the armature, which in some speakers is the diaphragm and in others a tiny piece of iron linked with the diaphragm.

This adjustment is to allow for the best possible setting under various conditions. The type or condition of the last tube in the set, the strength of the signal received, and to some extent the kind of material being reproduced by the loudspeaker, all affect the setting. The best setting is always at the point where the chattering just stops.

Some forms of cone type loudspeakers are made with what appears to be an adjustment screw at the apex of the cone. In most cases the purpose of the set screw or knurled nut is not to adjust the speaker unit. It is used to clamp the link wire to the center of the cone so that in especially dry or damp weather the nut can be loosened to relieve the strain caused by the contraction or expansion of the paper. Consequently, if you have a loudspeaker built in this way, you will find it a good idea to loosen up the nut and then tighten it again whenever the weather changes.

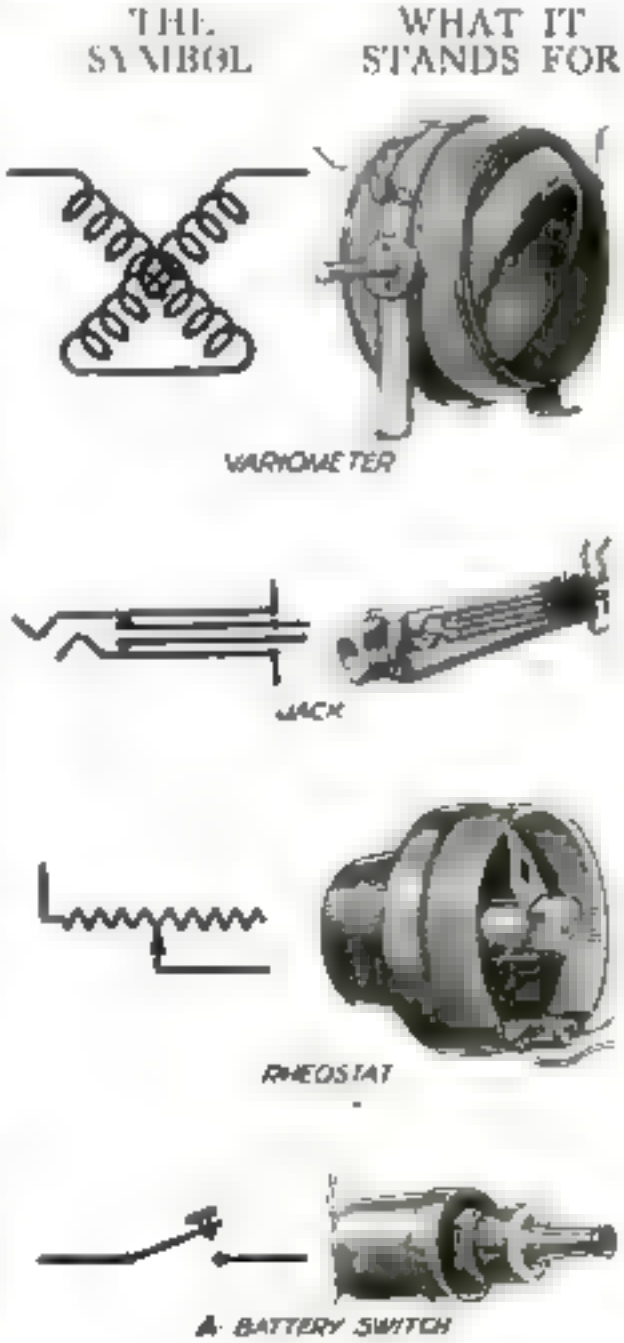
Be Sure to Get Right Dials

IF YOU buy some new dials, check up carefully on the direction of rotation of the condensers. Most makes of dials can be supplied with either right or left hand marking, and if you get dials graduated in the wrong direction for use on your condenser shafts you will find that the high wave stations come in near the zero end of the dial and the low wave stations tune-in near the hundred mark.

What the Symbols Mean

ALTHOUGH the variometer is not used as much as it was a few years ago we are including it in our last installment of symbols for radio beginners, shown below. The symbol for the jack is just a simplified view of the instrument it represents.

The rheostat is always represented as a zigzag line as shown in the illustration, regardless of whether the instrument it represents is of the wire-wound type or is made with carbon disks. The little arrowhead on the line near the zigzag line indicates that the resistance is adjustable. When this is missing, the resistance is fixed and may be anything from a few up to as many as several million ohms.



If *Your* Set Howls M*ysteriously*—

Maybe It Is Air Vibration—How to Remedy It

By Alfred P. Lane

NO MATTER how carefully your radio set is built, whether at the factory or at your home workbench, there are certain troubles that may interfere with the proper reception of the broadcasting. Static, of course, is the source of most of our interference. But even if you exclude static and all troubles that arise outside the receiver, such as grating and clicking sounds caused by poor connections either in the set or in the battery wiring, there are still noises that are the more mystifying because they are not easily traced.

You may go along for months with the new radio set you have installed in your home and reception may be perfectly satisfactory as far as unusual noises are concerned. Then some evening you will snap on the switch, tune-in your favorite station and settle back in your chair to enjoy the program. For a minute or two everything works as usual, but suddenly you become conscious of a slight but steady high-pitched humming noise. The hum rapidly grows louder and louder until it finally gets so bad that the broadcasting is drowned in an ear-piercing wail.

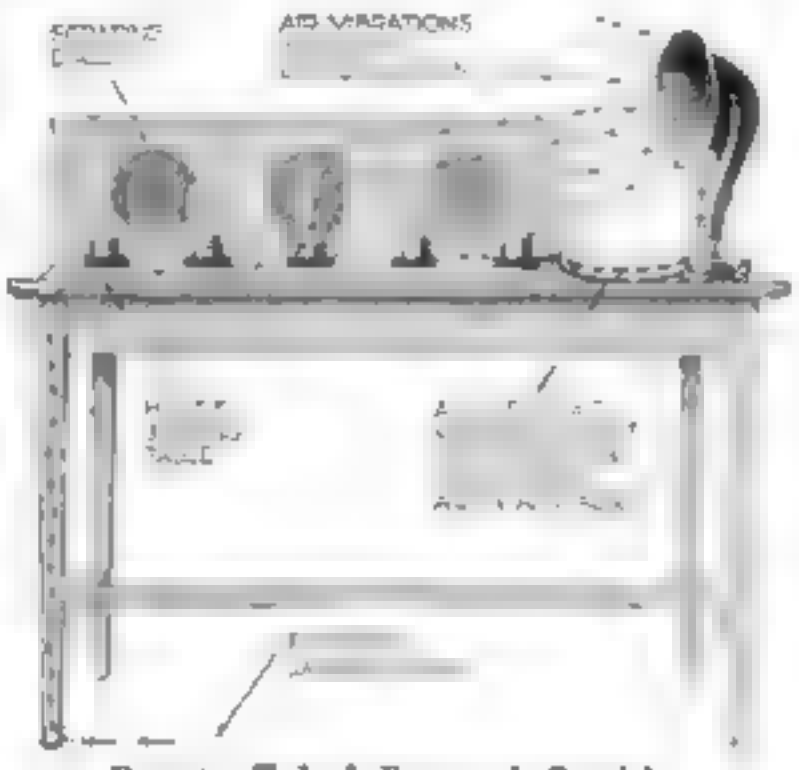
Your first thought is that something has gone wrong inside the cabinet, and so you turn off the switch and raise the lid. Perhaps you check up the wiring and do a little miscellaneous prodding around. Finding nothing amiss, you throw the switch again and the whole performance repeats itself.

This elusive trouble is called "audio feedback." Essentially it is an effect produced by the actual vibrations in the air that have their origin in the horn or cone of the loudspeaker. It is most likely to bother you when the loudspeaker is operating at full volume and particularly when the speaker is too near the radio set itself.

When sustained vibrations in the air strike against a solid object, the latter is thrown into vibration at the same rate. The strength of the vibration produced depends on the material of which the object is made. Glass, for instance, takes up vibrations very readily because it is so perfectly elastic, while other substances such as felt or cork act as dampers and are consequently used as noise absorbers.

A VACUUM tube such as is used in radio reception is a delicate piece of apparatus. Of necessity the elements inside the tube are light and subject to vibration. So if the glass tube itself vibrates, the elements in the tube are sure to vibrate also, and the electrical capacity of the tube changes in time with the vibration. This is true whether the tube is being used as a radio-frequency amplifier, detector or audio amplifier, but the electrical effect is far worse when the tube is acting as a detector. It is also true that tubes vary considerably in their reactions to vibration.

In your radio set the vibrations from the loudspeaker strike against the detector tube and start it vibrating. Each



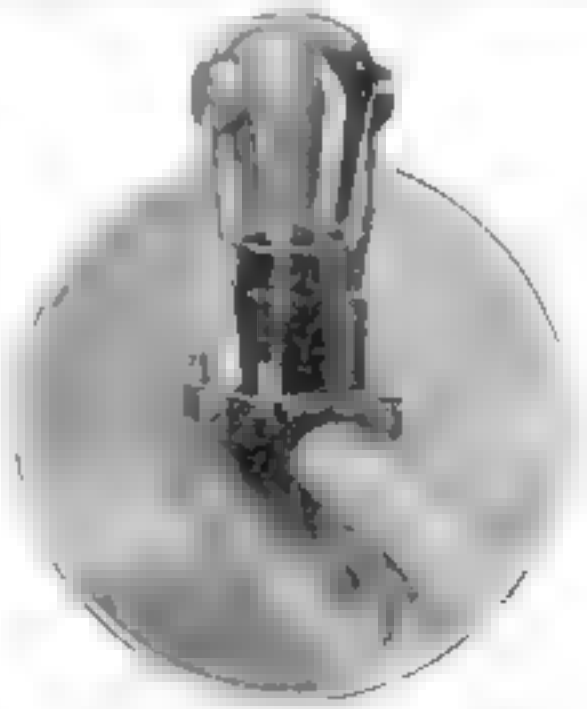
Detector Tube Is Extremely Sensitive

While the other tubes in your radio set also are affected to some degree by vibrations, the detector tube needs special protection to stop ringing and howling noises

vibration is reproduced in the electric current flowing out of the tube into the audio amplifier where they are amplified many times and sent on to the loudspeaker to be converted again into sound waves. The process really becomes a vicious circle and what started as a tiny hum develops into a terrific roar.

There are two ways to get rid of the trouble. One is to move the loudspeaker far enough away from the receiver so that the vibrations cannot start repeating themselves. The other is to fix the tubes in the set so that the vibrations cannot affect them.

Of the two methods, moving the loudspeaker is obviously the simpler. It may not be convenient for you to do this, however, particularly as, when operating at considerable volume, the audio feedback may cause trouble with the speaker as much as fifteen feet away from the set.



"Ear Muffs" Stop Vibration

The glass tube cannot vibrate in time with the air waves when it is held in contact with a material like sponge rubber, felt or cork

AND some of the ways in which audio feedback appears and disappears are weird enough to make the owner of a set thus afflicted think he has gone daffy. A tube may be in such condition that it is affected by the air vibrations when they come from a certain direction or with a particular intensity. You may find, for instance, that the howl grows weaker and disappears altogether when you change your position and stand on the other side of the table. Or you may find the same effect if you turn the loudspeaker part way around. Sometimes a terrible howl that develops when the set is open will fade away after the lid is down.

It is believed by some radio fans that a cushion-base socket will stop audio feedback. This is not true. Cushion or spring-base type sockets are valuable but not as a cure for audio feedback. Their function is to eliminate the ringing noises that are caused by thumps and bumps on the floor or table and which travel to the tube by way of the material in the table, the bottom of the receiver and the tube socket.

IF YOU have trouble with these ringing noises every time somebody walks around in the room or when you touch the radio table with anything hard that will cause a metallic click, the remedy is the spring-base or cushion type of socket.

Short of wrapping the whole set in a blanket or lining it with heavy felt, there is nothing that will stop a bad case of audio feedback except an "ear muff" type of socket such as is shown in the illustration at the left, or a homemade substitute constructed to accomplish the same result. In this particular type of socket, two light metal pieces are fastened to the base, and to the upper end of these pieces are fastened two pieces of sponge rubber. The same result can be attained by fitting a strip of brass to the baseboard or sub-base of the receiver and gluing a piece of felt to the top of it in such a way that it will press lightly against the glass side of the detector tube.

Touching the glass part of the detector tube will stop the howl if the trouble is really audio feedback. If you are having difficulty along these lines, it will be well to make this finger test before you start switching sockets.

How *Crooked* Radio Men Steal Your Money

As told to
JOHN E. LODGE

JUST one year ago, lacking a week or two, I graduated from an electrical trade school. A whole lot of things have happened to me in a radio way since then, and I can assure you that some of them are not going to happen again if I know anything about it! Also, I am going to show you how I worked out my own particular problem and you can save yourself a lot of time and money by judging according to the same plan when you set out to have your radio set repaired.

To begin with, radio has always been a hobby of mine. So the day after I got my certificate proving that I was a competent electrician with special training in radio, I set out to find myself a job as a service man. I thought I was lucky because the first store I struck needed a man. There is no use in telling you where the store was—the owner of the business left the state rather hurriedly a couple of weeks ago anyway and they are putting in a soda fountain where the radio store used to be.

"You're wise to this radio game, are you?" my future boss would up questioning me.

"Sure thing," I answered with plenty of confidence.

"All right, I'll take you on," he said briskly. "Here is a list of customers that called up yesterday and I promised 'em I'd have somebody around to see them today sure. Get busy and be sure to bring home the bacon," he added with a significant wink.

I took the list and started out. The first customer was a cranky old lady who said her radio wouldn't work. The batteries were on the floor under the table and somebody had evidently kicked one of the connecting wires loose. I clamped it back where it belonged and the set started "percolating" right away. The old lady was tickled to death. I made out a slip for what I'd done and got her to sign it.

The next call was just about the same thing only it was one of the loudspeaker wires that had slipped out of the plug far enough to break the contact. The third was run-down B-batteries and I promised to bring up a new set that afternoon. The fourth call looked like a real repair job at first. It was a fine apartment on the Drive and the radio was a real high-priced outfit. I turned it on and tried to tune-in a station and the loudspeaker was as silent as the grave. But it really was nothing important after all. One of the dials, I noticed, worked kind of funny and I found that it had come loose on the condenser shaft and the plates didn't move at all. A second's work with a screw driver and the set was as good as ever.

Only a Wire May Be Loose, But—

It pays to go to a reputable service station, otherwise a gyp may look solemn and render a big bill for "repairing the works." The accompanying article tells you how to protect yourself

AND so it went through the rest of the day. Practically all of the troubles were just little things that the owner of the set could have fixed in a jiffy. There was one loudspeaker that a heavy-handed owner had put on the blink by turning the adjustment too far. Luckily it was on the last call so I tucked it under my arm and headed for the shop.

"How did you make out?" the boss asked as I walked in.

"Fine," I replied, handing him the slips and going back into the shop where I started in to pull the loudspeaker apart to fix it. I'd just got the unit off when the boss came rushing in muttering to himself and mad as a hatter.

"Hey, you bone head!" he sputtered. "What do you think I'm running? A charity organization, eh? You said you was wise to the radio game and here you go and clean up all these calls without turning in a single one that there's any profit in! You got something to learn about this radio business, kid. Get wise to yourself! Make all you can out of every job. It doesn't matter if only a wire has come loose. Poke around a while inside and make 'em sign for adjusting up a whole lot of things. You can get away with it and they don't know the difference, see?"

I'M NO George Washington or anything like that but I didn't intend to start out my business career working for a cheap skate swindler.

"Guess you hired the wrong man," I said indignantly. "I won't be a crook for anybody!" And with that I jammed on my hat, picked up my tool kit and walked out.

It was a week before I located another job. I was keeping my eye open for gyp places and I passed up a couple of chances because they looked queer before I finally landed with a radio concern that appeared to be first class. The store was fixed up in classy style and the repair shop was fitted up fine. It was an inside job I got. They made a specialty of overhauling and rebuilding radio sets that were brought in by the service wagon—at least that's what they said in their advertising.

I noticed that there were a lot of sets parked on the shelves and benches, each one with a tag on it giving the name of the customer, the date it had been brought in and some symbols like they use in a good many stores to indicate the wholesale and retail prices.

Most of the repair jobs I did on the sets were trifling. In fact I couldn't understand why some of the sets had been brought in to be fixed. I'd hook on a set of batteries and it would work fine right off the bat. Sometimes it was just a burned-out tube or a loose binding post or some other simple thing that the service man could have fixed as well as not. I always wrote on the tag just what I found wrong and the boss would look over what I had written with a kind of a smile on his face and then he'd go in the office and make out a new tag with symbols on it.

I NEVER saw the customers at all. The boss and the one salesman he had took care of them. But one day while the salesman was out to lunch, the boss's wife telephoned and he had to go out right away.

"I'll be back in ten minutes," he said to me. "Take care of any customers that come in, will you?"

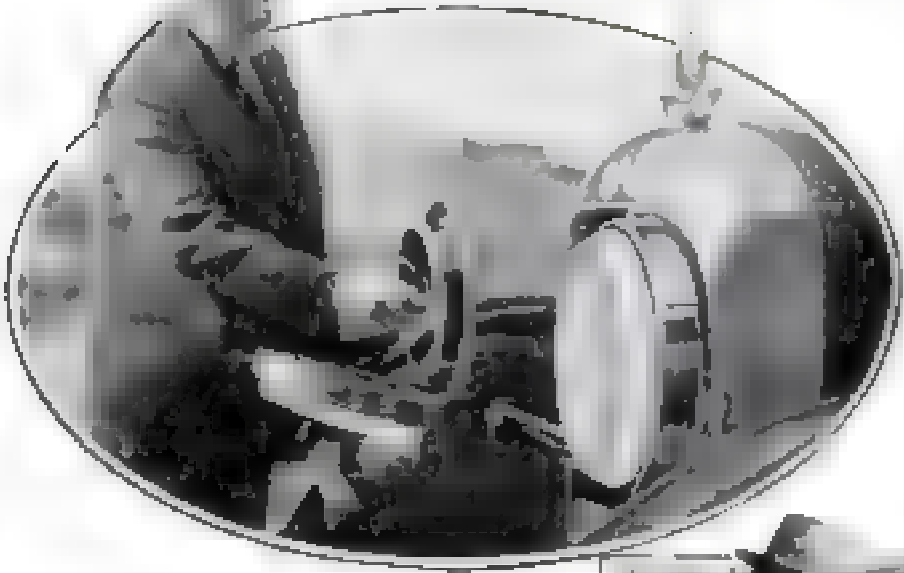
And then I finally tumbled to what was wrong, for a customer came in and gave the whole business away.

"What in Sam Hill do you mean by charging me ten bucks just for looking at my set and putting one new tube in it?" he shouted.

I happened to remember his set and he was right about nothing being wrong so I just stalled and told him to come in when the boss was around. He decided to wait for him and you'd better believe he handed the boss a mouthful when he did show up!

It was a slick scheme all right. A good many people that buy radio sets today know nothing about what goes on inside the cabinet so (Continued on page 119)

Ten Tips for Your Car

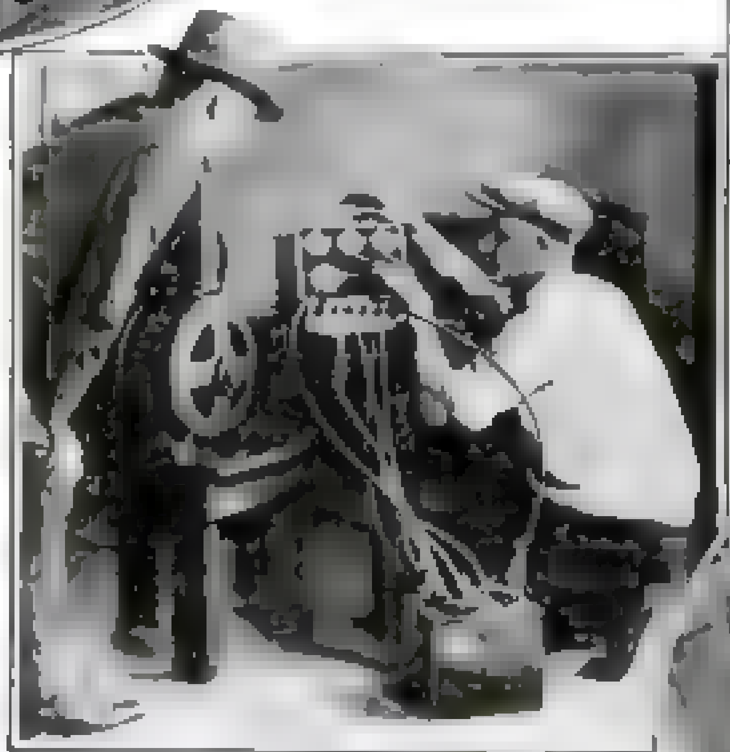


Extra Headlight Turns with Wheel

In going around sharp curves the [illegible] beam of light from an automobile usually is not [illegible] [illegible] [illegible]. [illegible] light [illegible] is mounted on the [illegible] of the frame near the bumper. A [illegible] to the steering [illegible] automatically turns it in the proper direction to light the road

Floodlights Roadsides Too

W. D'Arcy Ryan, of the General Electric Co., has just perfected a remarkable new [illegible] [illegible], shown [illegible] that [illegible] the road for 400 feet ahead and at the same time floods the ditches and signs on either side. And yet the glare is much less than with most of the present types of headlights. No focusing [illegible] [illegible] and the light cast by it is said to have excellent fog-penetrating powers



Tests Three Cells at Once

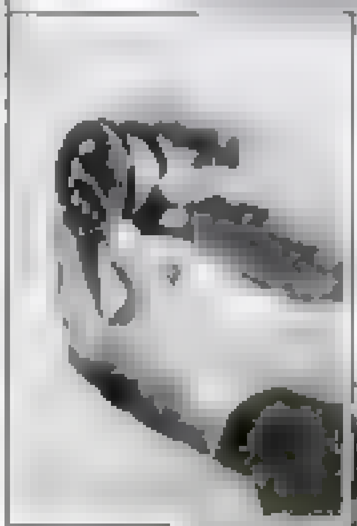
The voltage delivered by a storage battery while under heavy discharge is [illegible] [illegible] of the [illegible] of the battery. This ingenious [illegible] shows the [illegible] on a separate meter of each cell at one

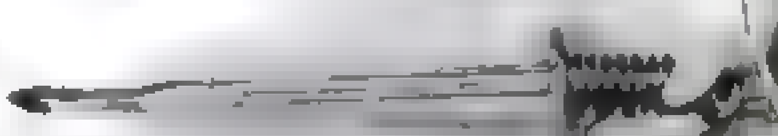
New Cotter Pin Puller

The handles of this useful tool are [illegible] [illegible] a pair of pliers. It is [illegible] [illegible] [illegible] themselves into the cotter pin head

Simple Electric Clock

Every thirty seconds a magnet [illegible] [illegible] always runs [illegible]. The current [illegible] the battery [illegible] [illegible] can be measured



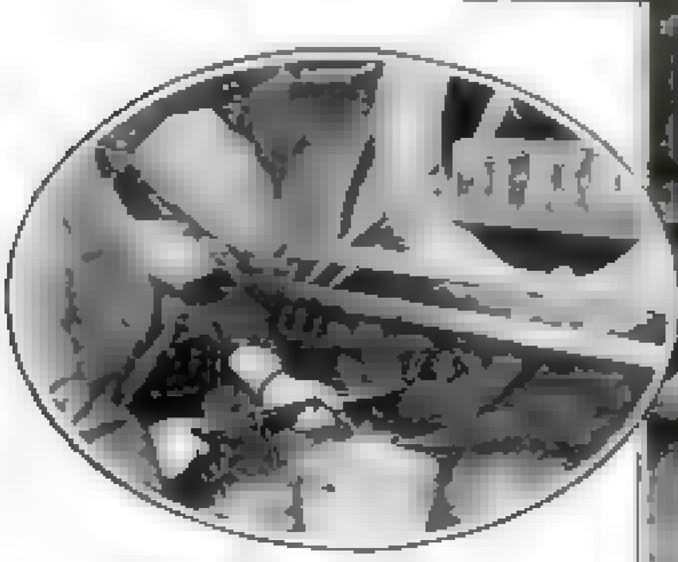


A Tool for Odd Corners

Above: The [illegible] fingers of [illegible] tool [illegible] [illegible] [illegible] pressing the spring [illegible] the handle [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] places such as an engine crank case

Handy Auto Washer

Attached to the end of the hose in place of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] sponge [illegible] ordinary way



Novel Gear Case Cleaner

This short pump is fitted with a gooseneck intake pipe that will reach to the bottom of the differential housing. Pushing the handle in and out pulls the grease or oil out of the differential by suction

Tire Lock Holds Wedge in Place

Above: This ingenious lock foils the tire thief by clamping the wedge in place so that it cannot be removed [illegible] [illegible] take the spare tire off the carrier. It is of very heavy construction and would be difficult to break

Remarkable Garage Door Holder

Left: The door [illegible] automatically when it is fully open. To release it one simply pushes the door beyond the catch point, which compresses a spring [illegible] [illegible] the catch to disengage and the door to close

Washing an Auto RIGHT *Isn't So Simple, Says Gus—How to*

Keep Your Car *in the* Pink *of* Condition

By MARTIN BUNN

"AND I ought to sue 'em for damages, too," growled Paul Murray as we lugged up a heated tirade against auto manufacturers in general and the makers of his own car in particular. He glowered at his shabby-looking car as he turned to Gus Wilson for sympathy.

"Aw, forget it," suggested Gus disgustedly. "If the finish on this car is on the blink it's your fault. Why didn't you take better care of it? You seem to think that a paint job ought to last forever even when you leave the bus standing for days at a time in the hot sun with half the mud in Benton County caked on it."

"If you think the factory did a bum job on your car, just come in here and I'll show you something," he finished leading the way toward the back of the Model Garage where Joe Clark, his partner, was checking up the work that had been done on a customer's car.

"Take a look at that bus," said Gus. "It came out of the factory about the same time yours did, and the speedometer shows as many miles. Like new, isn't it?"

Murray silently inspected the car Gus pointed out. He glanced at the speedometer. "Gee whiz, Gus!" I can hardly believe it," he exclaimed wonderingly. "How on blazes do he ever keep it so new? I bet he never takes it out if it even looks like rain!"

"HUMPH!" growled Gus. "The owner of that car goes out in any kind of weather. Rain doesn't stop him any more than it would a duck."

"Let me in on the secret, Gus," Murray begged. "I certainly can see I've got something to learn about keeping a car."

"Glad to," replied Gus. "There really isn't an awful lot to it once you get a good idea of what you are trying to do. The first thing to remember is that it's a whole lot better to give your car a little attention quite often than it is to wait until the car gets so bad that the womenfolk won't go out with you any more.

"And then you must always remember that what looks like nice, soft road dust is really ground-up sand—in fact, if you glued it onto a flat surface you could use it for sandpaper. The rough particles in dust will scratch hardened steel, and the paint, enamel or lacquer finish on your car is a whole lot softer than hard steel.

"Really, the whole trick in cleaning a car is to get the dirt off it without scratching off the finish, too. A fresh coat of dry dust is easy to remove. You can flick it off with a feather or wool duster. But dust in the form of mud that has dried and caked on sticks to beat the band."

"SO I've found," Murray broke in. "And if you try to rub it off the paint comes with it—or at least all the gloss anyway."

"Don't try to rub it off," Gus went on. "The way to get rid of dry mud is to soften it with soapy water so it will come off with a very gentle rub with a soft sponge. Don't be afraid to use plenty of water when you are washing a car. Let the mud alone until the water has had time to soak into it thoroughly. Take the nozzle off the hose before you start so that the water can run out in a gentle stream. If you stand off about ten feet and squirt it the force of the stream drives the gritty dust right into the paint.

Before removing dried mud, soften it thoroughly with water. Taking the nozzle off the hose so the water comes out easy in a gentle stream

"After you have it wet down, and the caked mud has turned to a soggy brown color showing that the water has soaked into it, go over the surface with a sponge and soapy water. A fistful of soft yellow auto soap dissolved in a pail of water is strong enough. Cold water is all right but it is better to have it luke warm—don't have it hot. You will find that the mud will loosen up and then when you flow a lot more water over the surface the particles of mud and the soapy water will be carried away leaving a clean, wet surface. Don't make the mistake of trying to soap the whole car at one time. Do a few square feet and then flow off the mud and soap because if you try to go all around the car with the soap you will find that it has dried in streaks by the time you get around to where you started.

"Wait a few minutes after you have run off the last of the soap and mud and then get busy with a piece of chamois skin and remove all the little drops of water that remain. If you let them dry on the finish they will leave spots."

"GOSH!" exclaimed Murray. "That's a whale of a lot of work to be done every time I get home from a ride."

"Who said every time?" Gus grunted. "It's much better to avoid washing if possible. Of course if you have been out in the rain and the car is covered with mud, the best time to wash it is right away before the mud has a chance to get hard. But if you make a practice of going over the whole car with a duster every time you put it away in the garage, you can go for weeks at a time without washing it at all. And if the car is not dusty the rain won't spot it so bad.

(Continued on page 1...)

The coating of dirt and grease on the running gear can usually be removed by painting it with kerosene left and a few hours later washing with soapy water

Right: After the mud is softened, the surface should be gone over with a sponge and soapy water. Then spray the soapy water off and go over the car with a chamois skin

Beautiful, Sanitary Floors at *low cost* and *upkeep*

CLEAN, bright, well-kept floors are the foundation of an attractive interior. NOW you can have them easily, quickly, inexpensively with the Johnson Wax treatment. It cleans, sanitates and polishes—all in one easy operation. It takes only a few minutes—there is no hard work—no stooping—no messy rags and pails.

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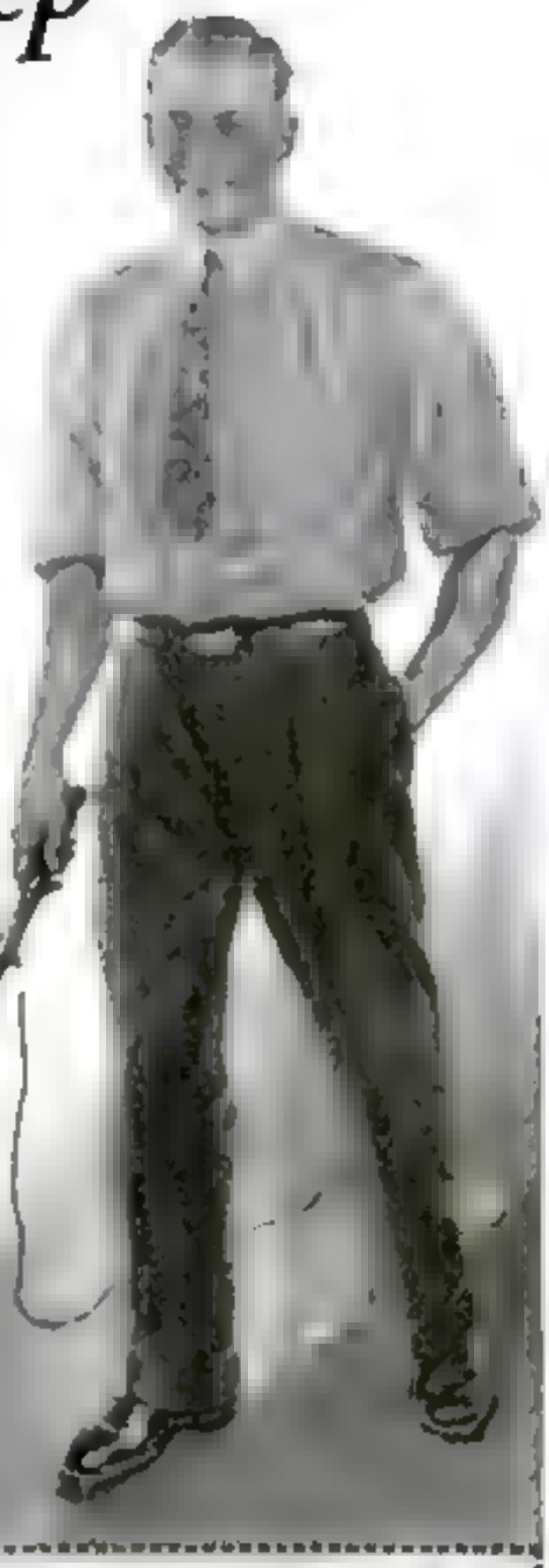
Ten times quicker and better than by hand—this marvelous labor-saving machine polishes *all* floors to burnished brilliance. Polishes under low-built pieces of furniture without moving them.

Nebraska State Capitol, Lincoln

Baltimore of the Late Empire Belvedere Hotel



For $2.00 a day you can rent a Johnson Electric Floor Polisher from your neighborhood store or from your painter. Or, you can purchase one for $42.50 (in Canada $48.50). With each polisher we give FREE a ½ gal. of Liquid Wax and a Lamb's-wool Wax Mop.

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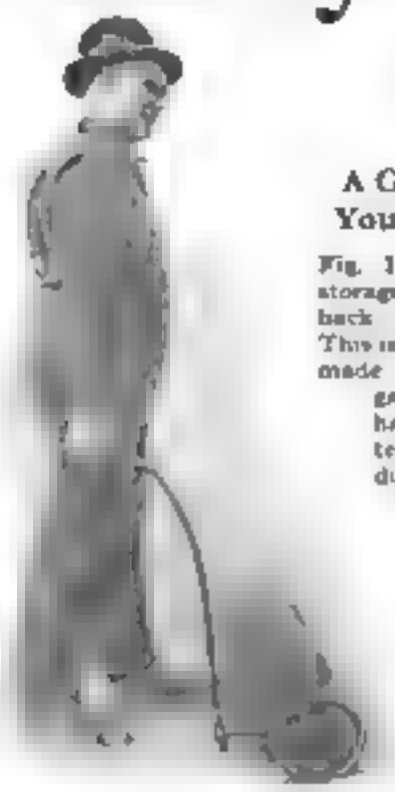
The Johnson Wax treatment is responsible for the floor beauty and securing in many of the largest and finest buildings in the United States and Canada—including the three pictured above.

FREE—25¢ Book on FLOORS

JOHNSON'S WAX
Electric floor Polisher

Handy Kinks for Your Auto

How to Carry Two Spares; a Tool Bag from an Old Tube



A Gocart for Your Battery

Fig. 1. Carrying a storage battery is a back breaking job. This is the way it was made easy by a garage man who has a lot of batteries to handle during the day

AN AUTOMOBILE starting battery is an extremely difficult piece of apparatus to handle. Aside from the fact that it is very heavy for its bulk, there is always the possibility that the sides and top of the battery will be covered with a film of acid-soaked dust. Consequently the man who has to handle the battery hesitates about lifting it in such a way that the weight will be partly supported by the body. Such a procedure would be ruinous to good clothes, and even a pair of overalls will go to pieces very quickly if exposed to acid rot

One battery service man has solved the problem by building himself the ingenious little hand truck shown in Fig. 1. It was made from a length of pipe, a piece of bent angle iron and the wheels from a broken Kokomo car.

WHEN the spare tire rack is built to hold only one extra tire and rim, the usual way to carry two spares on long trips is to strap the extra spare to the one that is bolted to the tire carrier. If, however, your car is fitted with rims made with lugs attached, Fig. 2 shows how to carry a spare neatly without straps. T-head bolts are used and sections of half-inch pipe are cut the right length to be spacers between the two tires. They should be long enough so that the rubber does not touch. Use at least three bolts on small tires and four or five on the larger sizes.

THE very serviceable tool bag shown in Fig. 3 is made from a piece of an old inner tube. Cut the tube about 1½ times the length of the largest tool that you want to put in it and then turn it inside out as shown. Fold neatly and compactly at one end, and bind as tightly as possible with a heavy rubber band also cut from the old tube. Turn right side out again, and, after inserting tools, close the end with another rubber band.

IN ORDER to prevent the wear caused by the heels on the floor mat just back of the clutch and brake pedals, a tough wearing surface must be used. One of the cheap, metal step plates sold in the bargain stores is ideal for this purpose. Fasten it to the floor with the turned-up edge toward the dash, as shown in Fig. 4

ADJUSTING the brakes is a job that usually requires the services of two men—one to hold the brake pedal down while the other adjusts both brakes so that they take hold at the same time

As shown in Fig. 5, a device can be easily built that will make it a one-man job. A half-inch standard turnbuckle can be fitted with special sheet metal pieces shaped as shown, so that one will rest securely on the foot brake pedal while the other rests against the edge of the driver's seat. Turning the turnbuckle will permit holding the brake pedal down as desired while the brakes are adjusted.

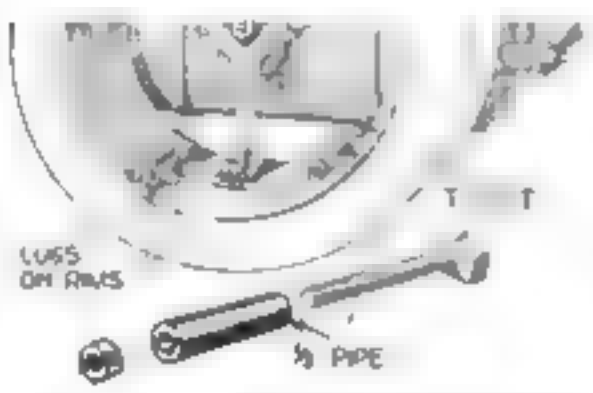


Fig. 2. T-bolts, nuts and short sections of pipe make it easy to take along an extra spare tire.

Fig. 3. A section of an old inner tube makes an excellent and serviceable holder for tools. It will not chew to pieces

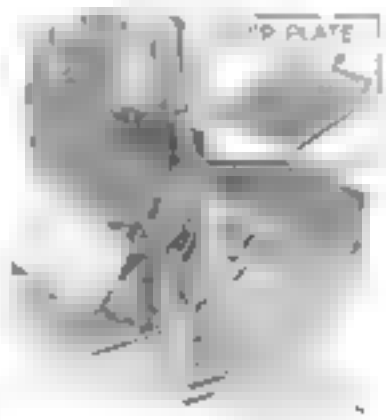


Fig. 4. Your rubber mat will last longer if protected by a cheap metal step plate

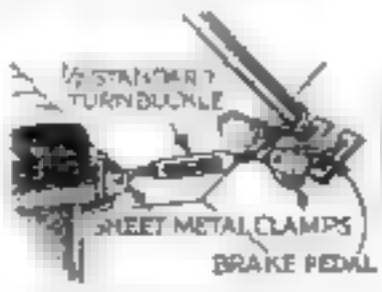


Fig. 5. This simple tool makes brake adjustment a one-man job. Heavy sheet metal feet are used

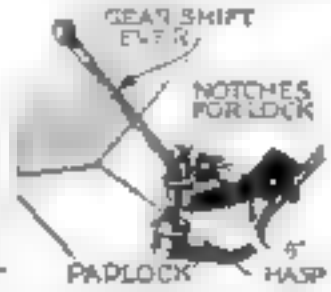


Fig. 6. A lock of this type will prevent unauthorized use of your car yet permits pushing

Fig. 7. Tie wires with string to help you remember the binding post to which each belongs

Fig. 8. A rolled up inner tube will act as shock absorber if a spring should weaken

Ten Dollars for an Idea!

ROWLAND L. Hill, of Saginaw Mich., wins the $10 prize this month for his suggestion of a practical way to carry two spares (Fig. 2). Each month POPULAR SCIENCE MONTHLY awards $10 in addition to regular space rates to the reader sending in the best idea for motorists. Other contributions that are published will be paid for at usual space rates.

IT IS simple enough to disconnect the wires and remove any part of the ignition system of an automobile, but the trouble comes when you try to replace the part and connect it up properly. Unfortunately, wire terminals all look alike and unless you mark them there is no way of telling to which binding posts they should be fastened. One simple way is to take a piece of string and as you disconnect a wire tie a knot around it as shown in Fig. 7. All you have to do is to remember the order in which you remove the wires—a simpler job than writing out a separate tag for each one. If you are disconnecting wires at widely separated points, use a different piece of string for each group.

AN OLD inner tube rolled up and wired to the center of the axle as shown in Fig. 8 can be used to prevent the frame from coming down solidly on the axle when you drive over an exceptionally heavy bump. It will also prove useful in case you break one or more of the front spring leaves. In the latter case, the tube should be rolled as tightly as possible and securely wired in place so that the constant pounding of the frame will not force it out of position. Of course if the spring leaves have broken in such a way that the pieces do not even keep the axle in position sidewise, you will have to use a piece of rope lashed around the shackles and the center frame to keep it lined up properly. At any rate you should drive with caution when anything is broken.

These qualities a good saw must have

SPRING and life, hardness, toughness, edge-holding, easy running, fast cutting—all of these qualities your saw should have.

It can have all of these qualities only when the steel is right.

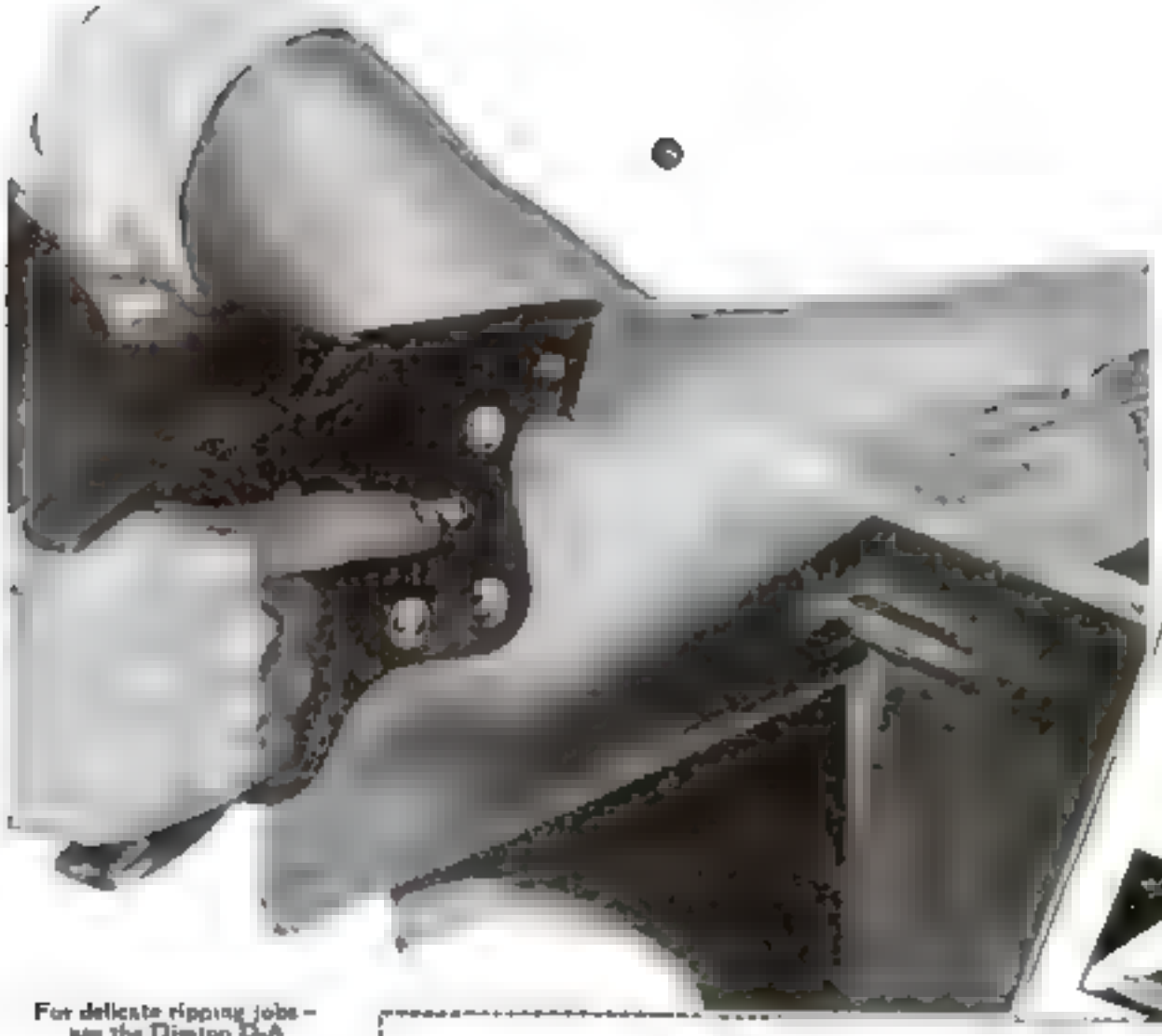
Saw steel must be stronger than the steel beams which support great buildings; and tough as the armor-plate that protects a battleship. It must sharpen to a razor-keen edge. Be hard, like a bank vault's door; springy as the main spring of the finest watch and polish like a precious metal.

Henry Disston knew that saw steel must have qualities that no other steel had. So he worked out his own Saw Steel, seventy years ago.

Then he tempered and tensioned his blades; tapered them for clearance in the cut, balanced blade and handle to move naturally with the arm—and the world had a saw that *cut*.

Today's Disston Saw, in your hardware store, is that saw, perfected through the years. Make it your own —and saw clean and straight, fast and easy, for a lifetime.

HENRY DISSTON & SONS, Inc., Philadelphia, U.S.A.
Makers of "The Saw Most Carpenters Use"



For delicate ripping jobs—use the Disston D-8 Rip Saw

FREE

From the world's largest saw maker—Facts about Sawing and Saws

For householders, amateur tool users,—for everyone who saws at all, Disston has prepared a Chart about sawing and about saws.

It pictures and tells the various ways that the proper saws can help you work easier, faster and better.

Even if you only do an occasional job around home, this Chart will be valuable to you.

Let us send you the Disston Saw Chart free, all postage paid. Just fill in and mail the coupon below.

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Send me, free of all charges, the Disston Saw Chart which gives valuable saw information.

DISSTON

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Is there a breakfast nook in your home?

NO wonder so many homes now have breakfast nooks. They save lots of work and add to the enjoyment of breakfast. It's not difficult to construct a little breakfast nook, yourself. You can also make your own work bench, porch swing, or bookcase. You can do scores of repair jobs around home. And among the pleasures of life there are not many which are greater than the satisfaction of making things with your own hands.

For satisfactory work you must have good tools. There are no better tools than Stanley Tools. Carpenters everywhere use Stanley Tools and Stanley Tools are used in manual training classes from coast to coast.

You can buy Stanley Tools separately and so collect your own set. For your convenience in buying, there are also sets of Stanley Tools at a wide variety of prices. In chests: from No. 904 containing 12 Stanley Tools at $15, to No. 850 containing 49 Stanley Tools at $95. Or there are assortments in strong cardboard boxes with simple directions in each for making your own chest. Prices $5 to $20.

Ask your hardware dealer to show you the line of Stanley Tools. Send for our Catalogue No. 34 which describes Stanley Tools both separately and in assortments. Address: The Stanley Works, New Britain, Conn.

The best tools are the cheapest to use
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THE MOST COMPLETE LINE

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The Home Workshop

Arthur Wakeling, *Editor*

Brushing Lacquers

After the lower part of the chair has been lacquered, it is turned right side up so that the back and seat can be finished

How to Make the Best Use of the New, Quick-Drying, Mar-Proof Finishes

By Ralph G. Waring

Specialist in Furniture and Auto Finishes

DAN—the "Smiler," we call him now—came bustling into the laboratory this noon, holding a small, attractively labeled can.

"Mother wants to know," he said, "whether this new brushing lacquer is any good. The paint store man told her it would dry in fifteen minutes—that it had so many advantages everyone was buying and using it. What do you think about it?"

"Well, Dan, that particular brand is fairly good. Brushing lacquers are less than a year old, so far as the market is concerned. Some brands are good; others not so good—and some are very bad indeed. I have tested those put out by the bigger companies, and while the claims of some are rather extravagant, yet there is no doubt in my mind that really fine brushing lacquers are being developed. A good lacquer not only dries almost immediately, but if it is properly applied, it gives a beautiful, lustrous surface of the greatest durability. There is no question about the revolutionary nature of the new finishes.

"At present some of the manufacturers who have no especial reputation to keep and are more interested on cashing in on the demand for lacquers than in maintaining a high standard for their products, have put out lacquers that dry too fast, so that they cannot be brushed at all. Other lacquers have the fault of streaking; some smell badly, which, though troublesome, is usually harmless; some attack the under surfaces and act as do varnish removers, thereby destroying the finish over which the new lacquer has been applied.

"I mention this because it would be a great pity if a finishing product that promises to be such a help to home painters—to everyone interested in keeping his home shipshape—should be judged at the start by the [illegible] the customary paint, varnish or enamel.

"This lacquer you have brought in is a clear or transparent brushing lacquer. You will find that no other material you have used will brush or 'handle' as does this lacquer."

I then showed Dan how to pry up the can cover carefully part way all around the top of the can, in order to allow the sawdust caught under the rim to be blown out. The cover was taken off and the edge of the container wiped clean. Everything about finishing must be clean and dust proof. And just here is another advantage—lacquers dry so fast that the surfaces remain relatively dust-free.

"IT CERTAINLY smells funny, doesn't it, Mr. Waring? Looks like a fine, pale varnish, but do you know I rather like the odor."

The best brush to use, I explained to Dan, was a soft-bristle type—fitch or bear—full chisel in shape. The black china brushes generally sold were not, in my judgment, satisfactory.

"Well, Dan," I said, "suppose you try one of these old chairs I am putting through for a practical experiment in the use of brushing lacquers. I sanded them to the raw wood, so that none of the old finish remained—just as you did on your mirror and table (Furniture Refinishing Made Easy, in the March, 1926, issue). After that I used a water stain to produce a mahogany color. A water stain was necessary because the usual penetrating stains cannot be used beneath lacquer."

The solvents of lacquer, I explained, attack stains of the ordinary prepared type and dissolve out (Continued on page 88)

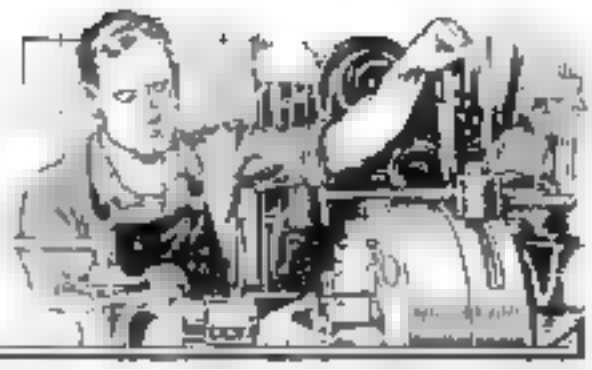
Applying the Lacquer

Mr. Waring giving a dresser case a coat of [illegible] brushing lacquer (above). Note how the brush is held. It is fully loaded with lacquer. The panel is [illegible] left and right [illegible] the center [illegible] the top, then the cross rails and finally the edges are finished. The first step in lacquering a chair is illustrated at the right

Turn to page 68 for the continuation of the Home Workshop Department.

Better Shop Methods

How Expert Mechanics Save Time and Labor



How Well Can You Grind a Drill?

Grimes Gives Valuable Tips to Help You in Making Holes in Various Materials—Importance of Using a Gage in Sharpening

By Albert A. Dowd

Consulting Engineer

"OH, IT'S easy enough to grind a drill so it will cut. Anybody can do that!" young Harvey Smith assured Mr. Grimes, the production engineer.

"That is true, *with reservations*, Harvey," responded the older man. "Yet few in the shop realize just how the actual grinding of a drill affects its cutting action. The average man in sharpening a drill simply grinds the two cutting lips (A and B in Fig. 1) to produce a keen edge, at the same time keeping the angles C and D equal. All he uses for a gage is his eye. Then he grinds the clearance E according to his own notion of what this should be and lets it go at that.

"Now, if you were to go to the tool crib and get a half-inch drill and the drill was dull, you would naturally take it over to the grinding wheel to sharpen it. The man who used the drill last may have ground it several times until the angles at A and B may be anywhere from fifty to sixty-five degrees instead of fifty-nine degrees as they should be. Then you grind it (*without a gage, perhaps*) and keep the angles as they were. Do you think you will get as good results as with a properly ground drill?"

"WELL," answered Harvey thoughtfully, "I think that two or three degrees wouldn't make very much difference in the cutting; but I know of men who believe that a more acute angle on the point of the drill produces a straighter hole especially when drilling cast iron in which there are likely to be blowholes. Is that really the case?"

"The angle of the drill point, when sent out by the manufacturer," answered Grimes, "is about fifty-nine degrees, and while there is some difference of opinion as to the exact angle, it is generally conceded to be suitable for most purposes. The clearance angle is usually about twelve degrees."

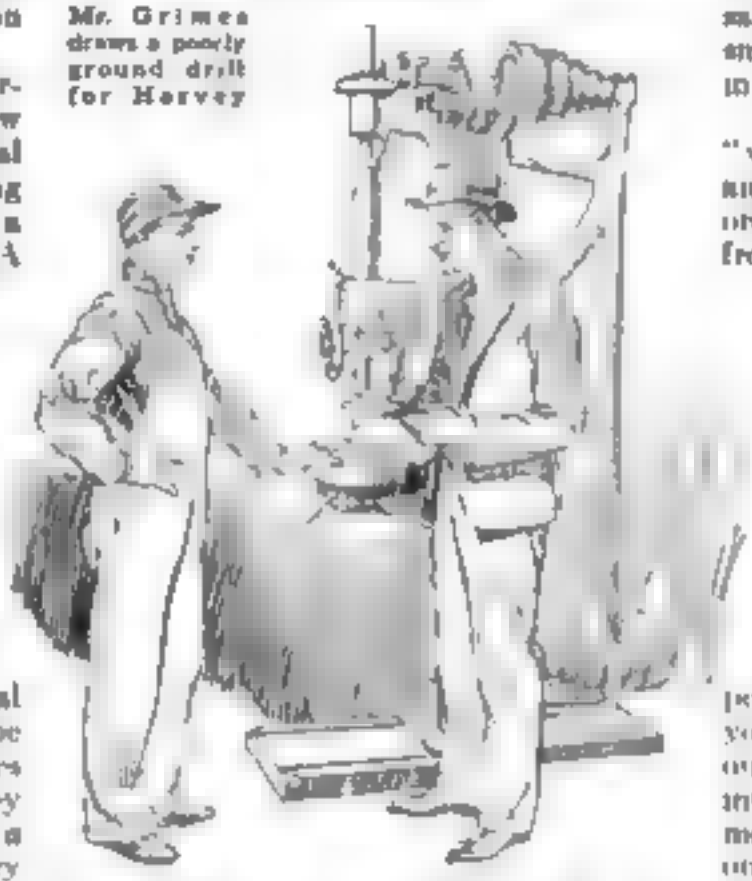
"Do you really think, Mr. Grimes," asked Harvey, "that a little variation from these angles makes any serious difference, I mean enough so that it would be noticeable in production work?"

"No, not a small variation," replied Grimes. "The danger lies in accumulated errors caused by different men grinding the drill without checking the angles with the gage now and then."

He made a rapid sketch on a piece of paper, like Fig. 2.

"Now, look here, Harvey. This is an exaggerated case in which the drill has been ground to a very acute angle. You see how much longer the cutting lip is from A to B than if it were ground properly to the angle as shown by the dotted lines, where the length of the lip would only be from A to C. You can easily understand that a long lip, A B would require more power than a short one, A C, and the torsion or twisting would be greater so there would be more likelihood of breakage. Also, the point would break down more rapidly

Mr. Grimes draws a poorly ground drill for Harvey



"I can see that plainly enough when you exaggerate the angle as you have done here," said Harvey, "but at the same time it doesn't appear to me that a small variation would have much effect in actual practice."

"True enough," admitted Grimes, "yet experiment has shown that the angles mentioned are the best for all ordinary work, and the more you depart from these angles the less efficient is your operation and the more frequently you have to grind the drill. Why not grind to the gage and do it right? It is very little more trouble."

"Oh, yes, I suppose so," replied Harvey, "but it's a nuisance to be bothered with the gage all the time. I always watch my clearance angles because if I don't the drill won't cut, but I never bother much about the lip angle as long as it looks right."

"Yes, the clearance is also important. If you have too much clearance your drill will chatter and probably chip out or the lip will break because it will dig into the work. In very soft metal a little more clearance is necessary—a little less on hard metal. The clearance at the point of the drill, of course, should be a little greater than at the outer edge.

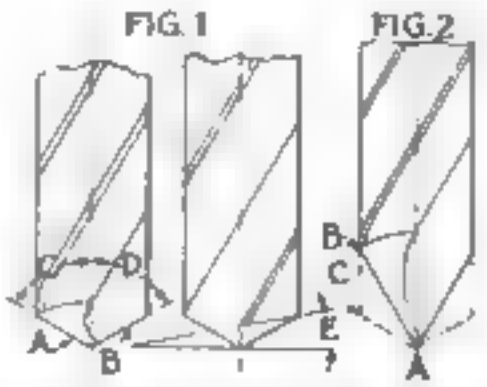
"THERE is another vital reason why you ought to use the gage in grinding (see Fig. 3, page 66). If you want to get a true hole of the right size, the point A must be central so that both lips are the same length. Otherwise you will get an oversize hole as shown in this sketch."

"If I can gain anything by doing it, I will use a gage hereafter," Harvey agreed.

"I'll tell you one thing," Grimes continued, "the man who succeeds is the one who takes advantage of the things that other people have found out by costly experiment. Neglect of these important points makes a failure of a job that would otherwise be a success. A careless workman has no business in a machine shop."

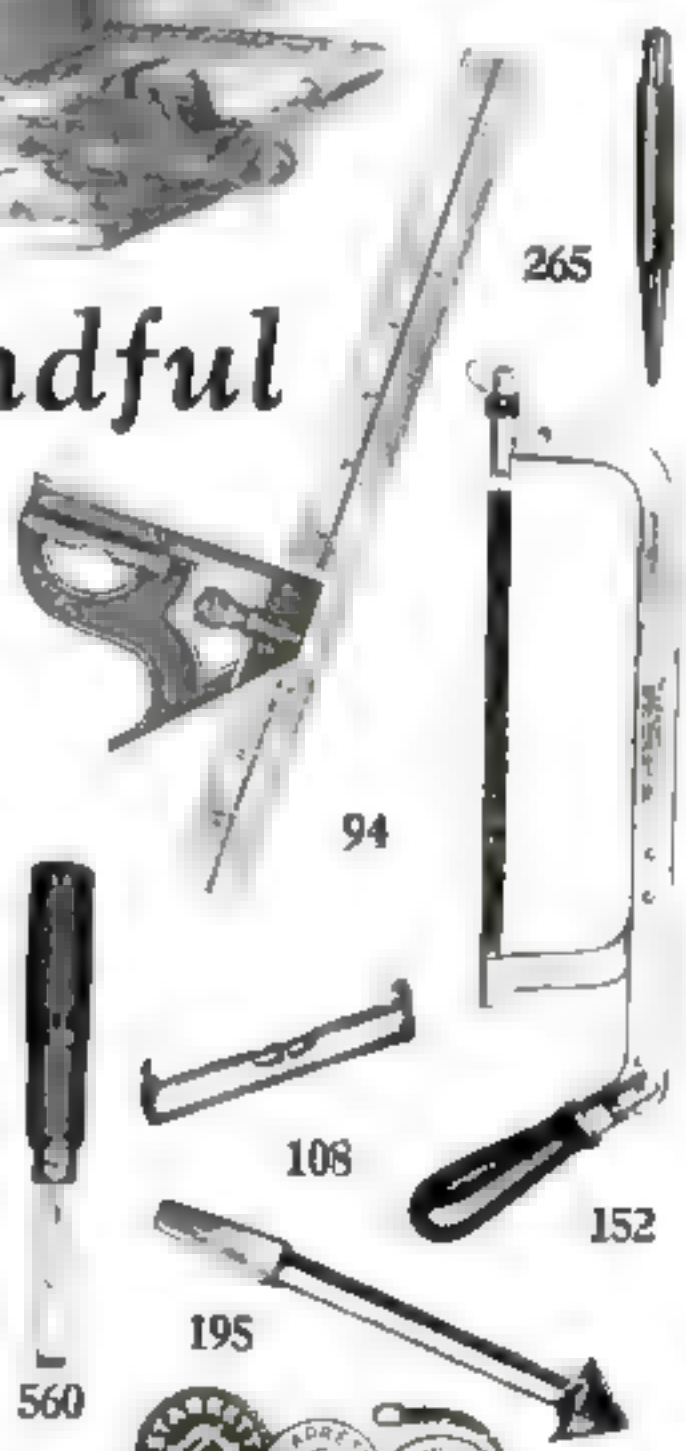
"There's a job over there on the floor that is causing us trouble, Mr. Grimes," Harvey remarked, pointing to a large pile of flat brass plates ¼ by 4 by 8 in., as shown at A, Fig. 4. "There are six quarter-inch holes to be drilled. We drilled a few and sent them to the assembling department. They (Continued on page 86)

There's a Lot to Drilling



If a mechanic guesses at the angles C and D and the clearance E, Fig. 1, he is practically certain to deviate from the standard form and may even approach the shape shown in Fig. 2

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 92 to 95 and 183.



Say! Here's a handy handful

"If I didn't have 'em in my chest, there's a lot of little jobs around the place that never would be done.

"There's the No. 94 Combination Square. That's seven tools all by itself—a square, plumb and level, height, depth and marking gage, miter and rule.

"There's the No. 152 Hacksaw Frame. The adjustable handle—sets in 13 different positions—makes that a lot different from most Hacksaw frames.

"And, there's the No. 500 Steel Tape, the No. 108 Aluminum Line Level, the No. 560 Insulated Handle Pocket Screw Driver—greatest thing on the light circuits you ever saw—the No. 181 Cabinet Scraper, the No. 93 T Handle Tap Wrench—best little tool in the world for hand taps, small drills, reamers, etc.—the No. 195 Double-lip Countersink, and the No. 265 Nail Sets—made square so they won't roll. That last is quite an item, too."

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Use Starrett Tools

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A Broom Cabinet: SOMETHING EVERY KITCHEN NEEDS

You Can Make This Vacuum Cleaner Cupboard at Low Cost

How to Give It a Porcelainlike Finish in Lacquer or Enamel

WHERE to put the broom, vacuum cleaner, mop, duster, and other cleaning appliances and materials is a problem in many kitchens. The best solution in most cases is to build a special broom cabinet.

The broom cupboard has, indeed, won a place in the modern kitchen comparable to the kitchen cabinet. It does not require much space, yet it holds a surprising quantity of cleaning equipment in an orderly and accessible way.

Like the kitchen cabinet, the broom cupboard has been developed into a more or less standardized product. The design illustrated embodies the best features of commercial designs, yet can be built at a relatively small cost for materials. It has been worked out in such a way as to avoid difficult joints or anything requiring special skill in cabinetmaking.

The joints are all of the "butt" or boxlike variety. The door facing and the end panels are not set into grooves in the conventional manner, but are planted on the surface of their supporting frames, which is by far the simpler method.

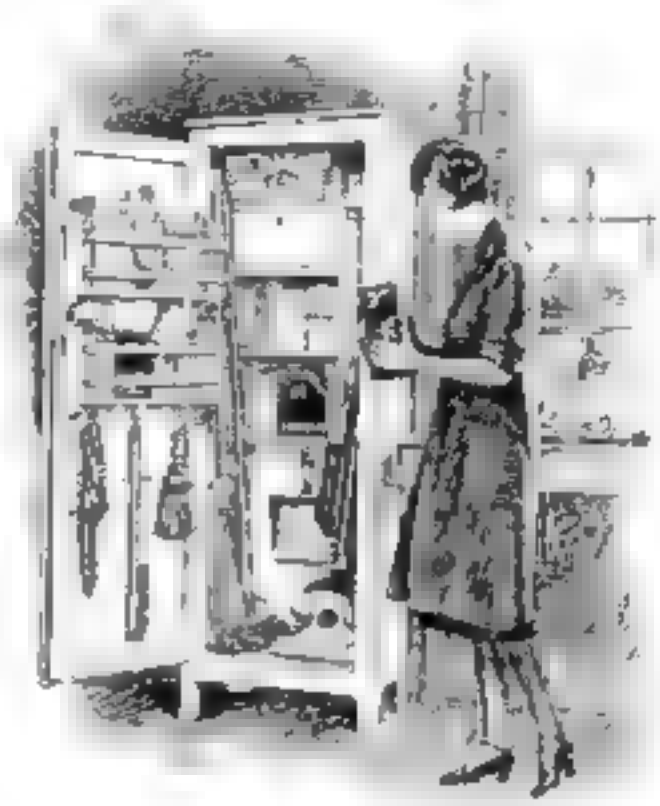
To make the work still easier, a blueprint has been prepared showing drawings of the cabinet in more detail and on a much larger scale than those accompanying this article, and also containing full size details of the corner construction, door, and door rack ends. Fully as valuable is the complete bill of materials, which shows the actual size of each part to correspond with the letters on the accompanying illustration. This blueprint, which is No. 49 in the Home Workshop series (see page 81), can be obtained by sending 25 cents to the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 250 Fourth avenue, New York.

Two new features have been incorporated into this blueprint. One is a suggested order of operations. This is a sort of abbreviated job sheet, which tells the way to carry the work through in orderly progression from beginning to end. The other addition is a suggested list of tools.

THE cabinet can, of course, be made with more or less tools than those mentioned on the blueprint, and the more experienced home woodworker will use his judgment in selecting the tools to use, as in all other problems that arise. But the beginner, who, perhaps, has never attempted to construct something of this type, will find the list of tools, as well as the order of operations, helpful.

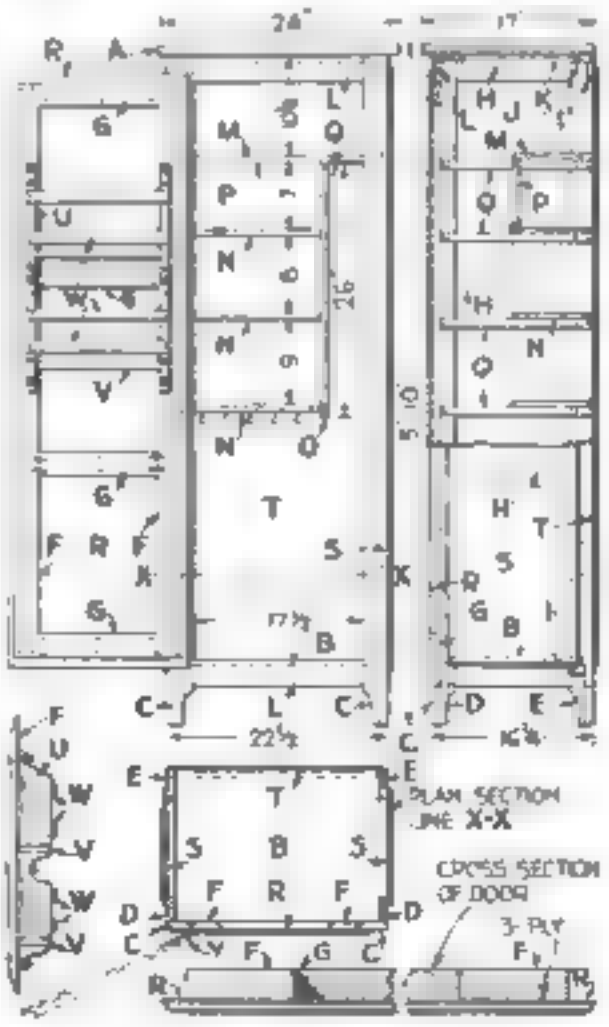
The framework can be made of whitewood, fir or any other suitable soft wood. The ½-in. thick three- or five-ply sheets of wood used for the door facing, end panels, and back can be fir, which is, perhaps, the most easily and cheaply obtained.

As it is intended that the cabinet should be finished either in enamel or wood lacquer, the kind of wood is of no great importance, provided it is smoothly finished and free from imperfections.



No modern kitchen is complete without a cabinet to hold the vacuum cleaner, brooms and mop

As the facing R of the door rests against the front framework (stiles C and rails L), it is obvious that offset hinges and an offset catch are necessary. Ice box hinges and catches of this type can be purchased at the larger hardware stores. Straight hinges and a straight catch can be used, however, by preparing pieces of plywood of the same thickness as the door facing R to fit underneath the standing part of each hinge and underneath the keeper of the catch. If preferred, a lock may be placed inside the door, in or on the stile F, to be opened with a knob or key.



Front, side and plan views of the cabinet and the construction of door and door rack

The first step in finishing the cabinet is to sandpaper the woodwork as smooth as possible and round all the edges and corners ⅛ in. to prevent the enamel or lacquer from chipping off after it is dry.

IF one of the new brushing lacquers is to be used, first apply a coat of dilute white or orange shellac and let it dry three hours. Make up a putty of one part white lead and two parts whiting thinned with a few drops of japan drier and work until soft in the hands. Fill all nail holes, cracks and dents and give the putty time to dry hard, after which sandpaper the case smooth with No. 00 paper and dust it off carefully.

Wash out a 2-in. fitch brush in lacquer thinner and dry it. Then lacquer all the panels with as little brush work as possible. Apply the lacquer the short way of the panel and keep the strokes straight. Lacquer the cross rails next and the stiles and legs last. Finish one side completely before proceeding to the next. Let stand until thoroughly dry, preferably three hours, and apply a second coat, which should be allowed to dry overnight.

Brushing lacquer, when dry, may be rubbed with a felt pad, FF pumice stone and water, if desired, just as if it were varnish. If you can obtain No. 0-0 or No. 8-0 water sandpaper it will be found a help, especially where the rubbing must be done in a straight line. If sandpaper is used, a very light finishing rub may be given with the FF pumice stone, felt pad and water.

For an enamel finish, brush on a coat of good varnish to "size" the wood. Let dry overnight or until hard and sandpaper with No. 00 paper, if you wish, remembering that a smooth enamel coat will depend entirely upon a smooth under surface.

Putty all holes and dents with one-third white lead and two-thirds whiting and a few drops of varnish rather than linseed oil. When hard, sandpaper smooth.

Apply a coat of half undercoater and half enamel, white or colored as desired, using a 2-in. fitch brush or other soft-bristle brush. Let dry until hard and give a second coat of undercoater. Wash the brush clean with fresh turpentine and dry thoroughly.

Then, when the undercoater is dry, brush on an enamel coat. Run a stroke around a panel, brush crosswise, then finish the panel by (*Continued on page 69*)

The Home Workshop

A Fence Hurdle You Can Quickly Nail Together

THIS hurdle is one of the simplest that can be made for crossing a woven or barbed wire fence without the use of a gate. Three horizontal bars are nailed to a post to form the steps and are braced with two vertical pieces and two diagonals placed as indicated.—G. A. Lucas.

Making a Saxophone Stand

The finished stand

I WANTED a neat stand for my saxophone but found the only kind I could buy was one with a base altogether too wide for the top of the piano or bookcase. To meet my needs, I devised the stand illustrated from the base of an old globe and a stout wire. The base was re-varnished and the wire gilded attractively.—C. L. Meegan.

Easily Built Broom Cabinet

(continued from page 68)

stroking from the top halfway down and from the bottom halfway up, so that the brush leaves the enamel lightly at the center. Lay on the enamel evenly so as to avoid sagging. Enamel all cross rails, after which brush out the stiles of the doors and the leg frames.

One or more coats of finishing enamel may be applied at five-day intervals. When the enamel is thoroughly dry, it may be rubbed with a felt pad, FF pumice stone and water. If a flat finish is desired without the trouble of rubbing, an eggshell enamel should be used in the first place.

The broom cabinet was designed by George F. Kaercher, for many years a furniture factory superintendent. The lists of operations and tools were arranged by Charles A. King, one of the leading authorities on construction in wood. The finishing specifications were prepared by Ralph G. Waring, consulting chemist and wood finishing expert, of Syracuse, N. Y.

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Thrills in Water Scooting

How You Can Construct a Surf Board with Least Effort

By F. W. HARTH

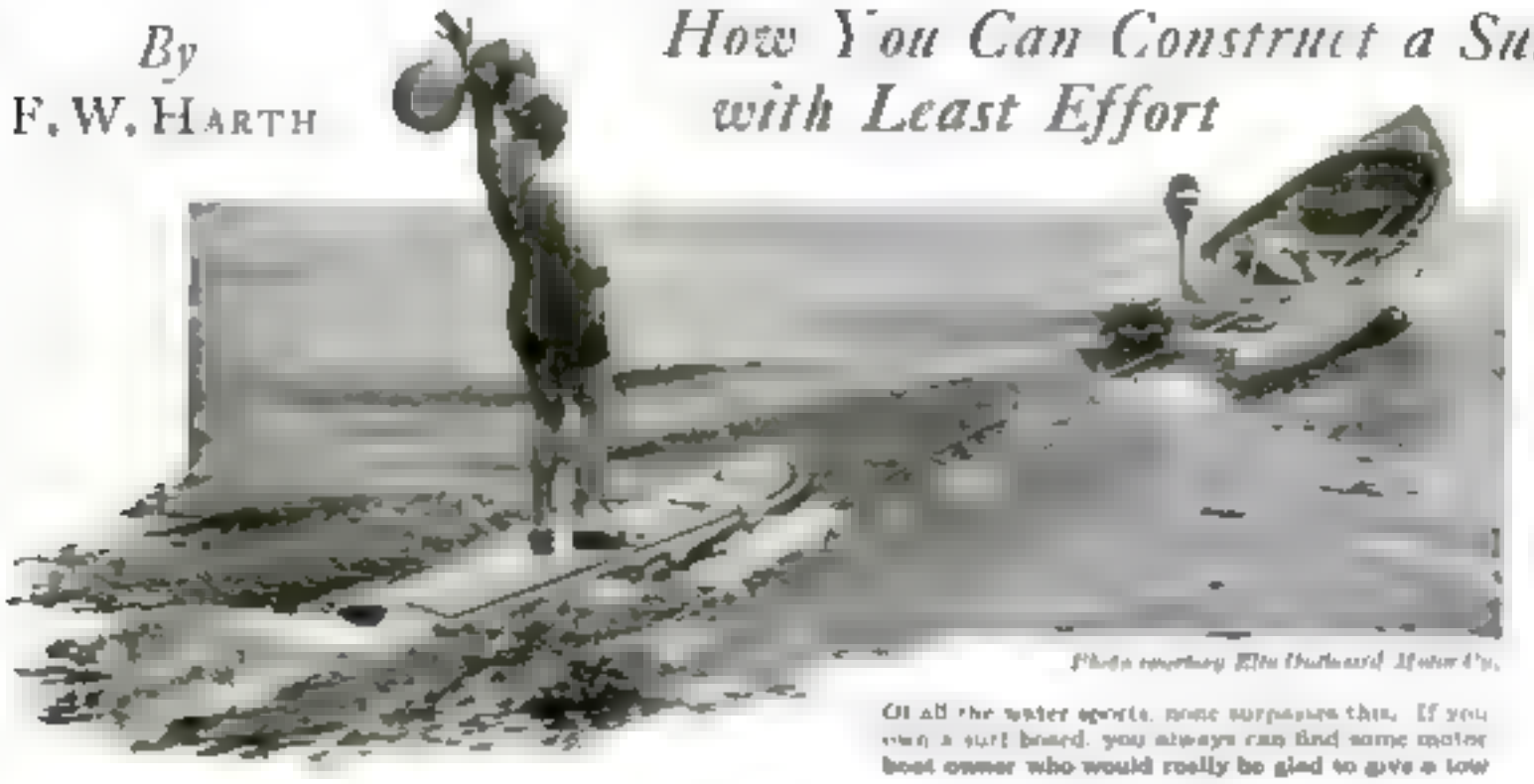


Photo courtesy Elto Outboard Motor Co.

Of all the water sports, none surpasses this. If you own a surf board, you always can find some motor boat owner who would really be glad to give a tow

RIDING a surf board, most thrilling of water sports, is within the reach of anyone who will take the trouble to build a water scooter.

Once you have a board, it is an easy matter to get a "tow." Even if you have no motor boat of your own, you will always be able to find some jolly boat owner who will take your line—and then you'll be in for a breath-taking, spray-drenched, skimming flight over the water that is like no other sensation on land or sea.

To ride a surf board at slow speed is, of course, simple enough. It is not especially difficult to keep one's balance; one can lie down at the start, if necessary, and rise to a standing position as the surf board gains speed. But riding at really high speed requires skill and practice and is a sport only for seasoned swimmers.

A couple of boards cleated together will serve as a water scooter, but the best type is built like a canoe.

It is quite within the means of the home worker to construct a surf board resembling the latest and finest commercial model. A study of the accompanying drawings and the bill of materials on page 83 will show the method of construction.

This design combines grace, strength and durability and, indeed, corresponds to a 1926 commercial model of the finest quality. The construction, however, can be simplified in many ways. For instance you can make the bow straight across, if the bent work seems too much trouble.

Other woods than those mentioned can be used satisfactorily. If the finished scooter leaks a trifle, it will make no great difference as an outlet is provided for drainage.

IT IS best, perhaps, to begin with the molds C, D, E, F, and G (Fig. 4), which are alike (except that G is 1½ in. shorter than the others). Four boards ¾ by 4 by 24 in. are required. Clamp them together (Fig. 3) and mark the curve on both sides. Shape them roughly with a saw or drawknife and plane to the line. Mark and cut the notches ¾ in. deep.

The molds H and J, being of a different size, will have to be cut separately, but one of the previously made molds can be used as a pattern for the notches on mold H.

The brace B, which is ¾-in. thick oak, can be clamped up with the molds first mentioned, if desired, and cut at the same time. If cut separately, it can be marked from one of the molds. The brace B can be used as a pattern for cutting the stern piece H, which is the same shape but ¾ in. thick.

The sides M and M¹ (Fig. 2) are ¼ by 1 ⅛ in. by 4 ft. 4⅝ in. The bow piece K may raise some concern, but if a pattern is made by enlarging the diagram at Fig. 4 no difficulty should be experienced. Cut the piece, soften it thoroughly by steaming or boiling, and then fasten it around a temporary form to correspond to the curve of the bow.

There are several ways in which a piece of wood of this length can be steamed or boiled. An old water pipe or smokestack can be used as a boiler by plugging one end with cement or by simply burying the ends in the ground. The pipe is supported in an inclined position and filled with water. A brisk bonfire is kept going underneath and the wood is reversed from time to time until it is thoroughly soft.

Another way is to build a long box from waste lumber and connect it by means of a rubber hose with a kettle or other source of steam.

To assemble the frame, first screw the brace B to the stern piece A with heavy 1-in. brass screws. (Continued on page 82)

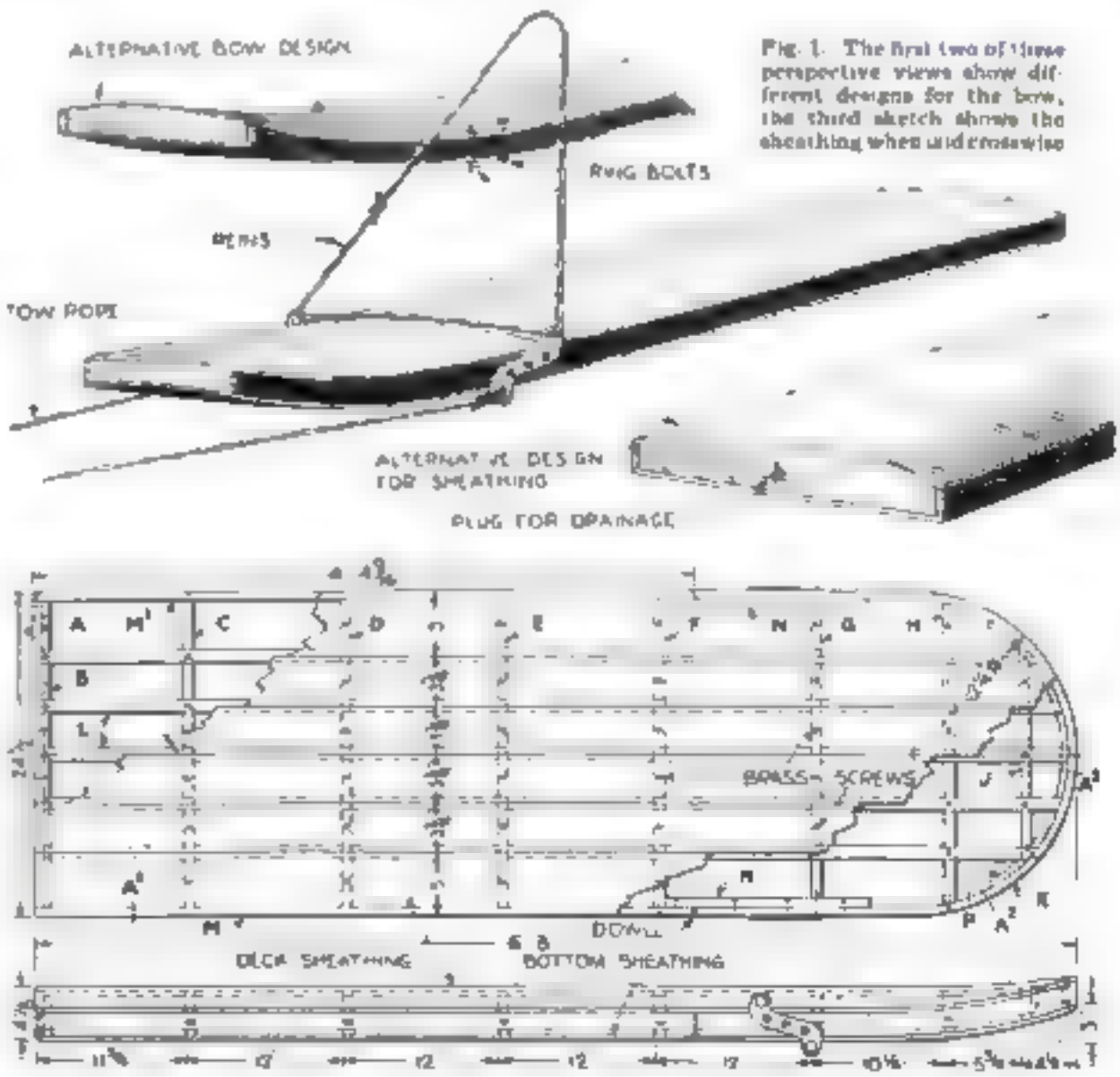


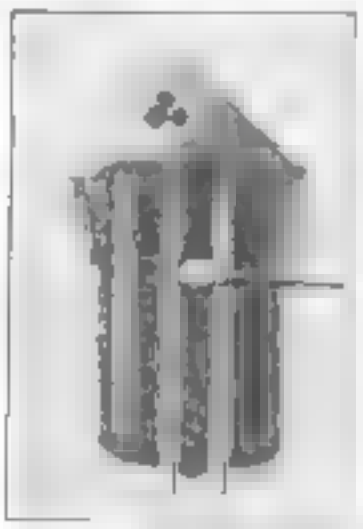
Fig. 1. The first two of these perspective views show different designs for the bow, the third sketch shows the sheathing when laid crosswise

Fig. 2. Top and side views. The construction is simpler than it looks—a series of mold boards bounded by side pieces, all braced with strips of ribbing and covered with thin wood

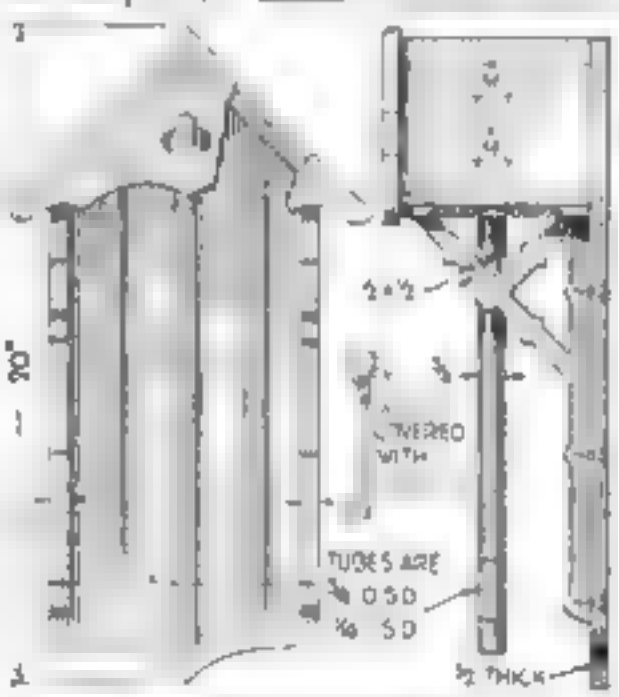
Profit in Making Dinner Chimes

By W. A. Schaerr

ABOUT a year ago I made the set of dinner chimes illustrated. Some of my friends who saw them liked them so well that they wished me to make duplicates for them. So far I have made seven at prices ranging from $7.50 to $10, my profit amounting in all to $42.



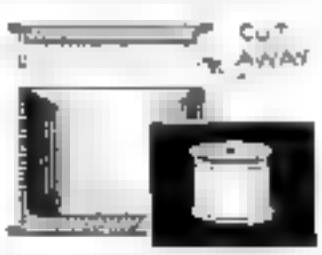
The case can be fastened to the wall by means of mirror plates, or directly with screws into a stud, or it can be hung up by means of wire to the picture molding, which is the method I have used.



How the completed chimes look, and views showing construction. The tubes are of brass

Before attempting to make the case a full size drawing should be prepared and used as a pattern for laying out the parts. The design, of course, may be modified in many ways, and carving, inlays or other ornamentation added.

Tobacco Jar from Gun Shells



ONE of my friends recently made a useful and very good-looking tobacco jar from two 18-pounder shell cases—souvenirs of the war. A shell was cut off about 8½ in. long to serve as the body of the jar and turned smooth inside; another was cut just about ¼ in. from the rim and turned as indicated to serve as the lid. Both pieces were polished in the lathe by means of emery dust.—S. W. Blanchard.

Hundreds of Uses Everywhere

Rogers Brushing Lacquer opens up a new and limitless realm of color "painting." The ease and speed of application; the quick drying feature which saves time and confusion; the beauty of the rich, glossy colors; and the amazing durability—make it desirable for finishing or renewing an endless variety of things in the home; in stores, offices, factories, buildings of all sorts; in art shops, hotels, schools and businesses of many kinds

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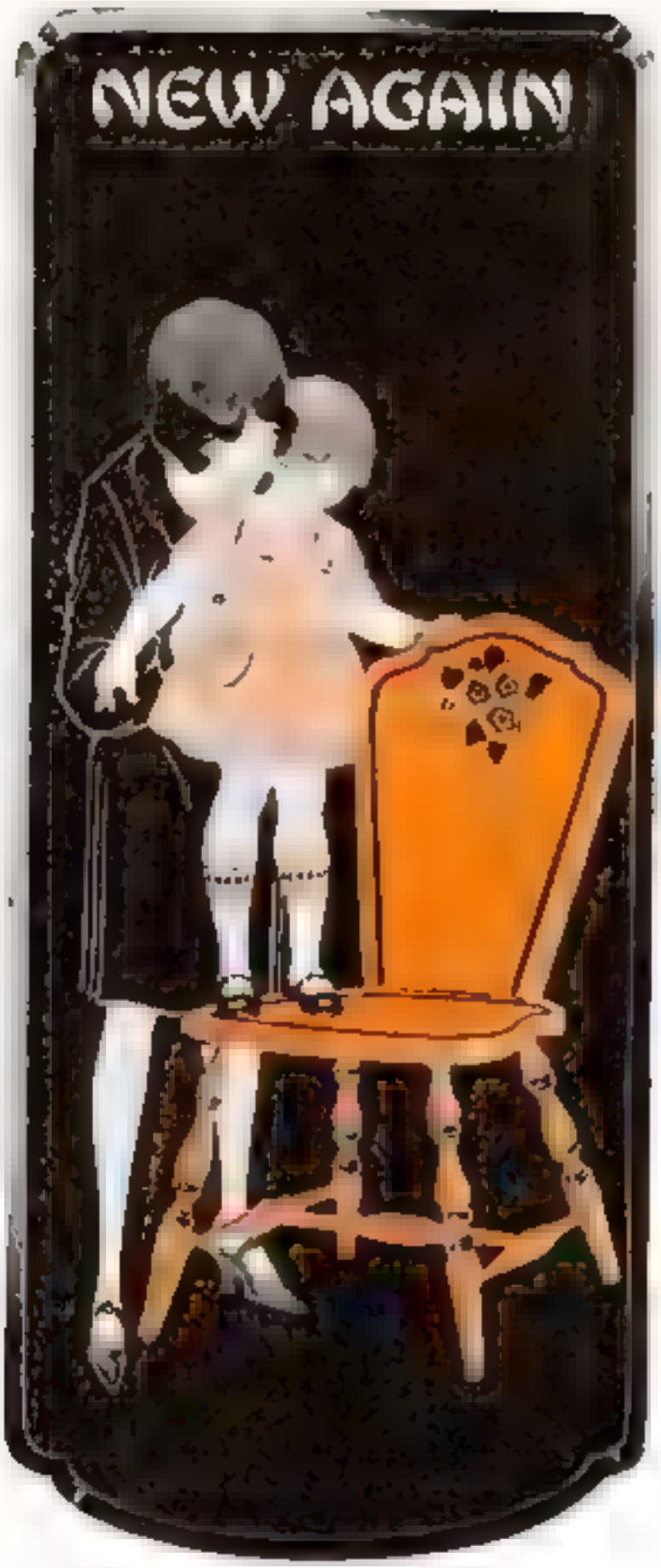

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Try a can of Rogers Brushing Lacquer. If not more than satisfied return what is left to your dealer. He is authorized to refund the entire purchase price

You have seen the beautiful *new lacquer finish* used on fine motor cars and furniture. You have heard how it withstands the roughest usage. Heretofore this amazing lacquer could only be applied at the factory with special equipment.

Rogers Brushing Lacquer now offers you a *perfected* lacquer *for home use*. You apply it freely with a well filled brush—*right over the old finish*. Covers perfectly. Brushes out smoothly and—

Dries While You Wait!

You lacquer a chair and sit on it a few minutes later. You lacquer a table and within half an hour put on the tablecloth for dinner. You lacquer a floor and thirty minutes afterward walk on it. There are almost endless uses in every home, store, office, building, hotel, etc.

And the rich, lustrous, colorful finish is practically indestructible. Wears like porcelain. Does not print or hold line. Does not gather dust.

DEALERS everywhere carry the genuine Rogers Brushing Lacquer. All the popular colors, also white, black and clear. Ready mixed and ready for use. Anyone can apply it. But be sure to get "ROGERS" in the Oriental can—the kind that is sold on a publicly advertised money-back guaranty.

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ARROWS—

What You Should Know About Them If You Take Up the Revived Sport of Archery

Remington Schuyler, cover artist of Popular Science Monthly, and a noted archer, shows how to string a bow and shoot an arrow. These weapons were made by Dr. Saxton Pope

By DAN BEARD

National Scout Commissioner
Boy Scouts of America

SPORTSMEN in the true sense of the word, with real red blood coursing in their veins, should follow the example of Stewart Edward White, Saxton Pope and Arthur Young, and put away their death-dealing guns, and arm themselves with bows and arrows. Then, as they enter the game fields, they will do so with a knowledge that they are playing fair and giving the wild animals a more even chance in the contest.

A bow without an arrow is like a six-gun without ball or powder, it is like an anvil without a hammer, it is like a man without a wife. The two things must go together to be complete.

To begin with, if you fellows are really interested in archery, by all means read Dr. Saxton Pope's "Hunting with the Bow and Arrow" and the intensely interesting story of Ishi, the Indian, the last of his tribe. Many of you have read "The Last of the Mohicans," which is a fable, but this poor Indian was really the last man in his tribe. No one could understand his language, he was alone in a world that had forgotten his people. But Ishi knew how to chip a flint arrowhead, knew how to make an arrow, and knew all the arts of the man of the stone age. That's the reason we are interested in him.

Back in the times before history was written, that is, before it was written in books, the arrow was made of any long slender piece of wood. At times even a reed was used for that purpose. The shaft was about 30 in. long and usually tipped with a pointed flake of flint or other hard stone.

OUR American Indians also used cane or bamboo tips for their arrows, the tips being hardened in the fire, but usually the stone arrowhead was favored by the experienced Indian.

To make an arrowhead from a flake of flint, place the flint on a pad of buckskin, and put the wedge-shaped point of the flaker (this is usually a little stick of hard bone or the tip of a deer's horn) against the flint near its edge. Then press heavily and quickly downward. Off flies a tiny disk of flake or flint.

You turn the flake over, feel where the first chip was removed, and repeat the operation. That is all there is to it, but as in all things, skill, strength and knowledge count. Freshly split or broken flint flakes are best. When not being worked, flint should be kept in moist earth.

There has always been a great mystery regarding the flaking of an arrowhead and all sorts of legends and romance are connected with it. We used to think it was done by heating the flint red-hot and then throwing water upon it, but now we know that the method is childishly simple and anyone who takes pains can do the trick, that is, if we do it as the Indians were wont to flake their arrowheads by the use of the "hammerstone."

FIRST, you must have a round hammerstone about the size and shape of a goose egg; this you hold in your right hand while in your left hand is the chunk of flint. A couple of quick, heavy blows of the hammerstone on the flint chunk near its edge will break off small slabs or flakes of varying size and thicknesses. These flakes are the arrowhead material.

Of course, you can flake an arrow without a hammerstone. You can do it by pressing down on the flint with your flaker and chipping it off with the line of cleavage, or as the boys would say, with the grain.

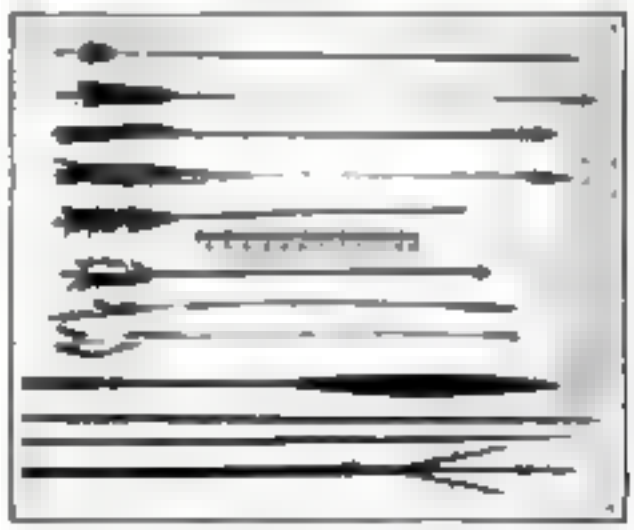
Back in the frontier trading post days the traders sold iron arrow points to the Indians at the rate of five cents a point, which in Pittsburgh cost one-tenth of a cent to make. Out in the Navajo country in a trader's store my assistant saw a small box of, perhaps, two hundred of these points, left over from the days of the hunting bow.

The placing of feathers upon the shaft of an arrow was a big advance in archery, but just when it occurred is unknown. It is interesting, however, to note that our American Indians had feathered shafts long before Robin Hood's day.

The average Indian arrow was about 28 in. long, often made of a dogwood shoot, feathered with three bits of turkey feathers, tipped with "trade point" of iron, all wrapped on with deer sinew. The Plains Indian usually cut shallow grooves on his arrows for blood draining.

Only our old-time Plains Indian seemed to prefer a short arrow. That was because he was a pony-riding man; no "walkee, walkee" for him.

Those who followed closely last month's article have, no doubt, already made arrows by the method suggested. Compare your arrows with the first two arrows shown in the illustration on this page. For ordinary purposes, however, use a blunt arrowhead; the point should only



Twelve arrows from the collection of Remington Schuyler. First, a 26-in. English target arrow. Second, a steel pointed hunting arrow made by Dr. Pope from a common 5/16-in. birch dowel, exactly as described last month. Third, steel pointed Crow arrow. Fourth, Apache arrow. Fifth and sixth, old flint head arrows from an Indian medicine bundle. Seventh and eighth, ancient Sioux arrows. Ninth to twelfth, points of very long arrows used by Pacific Islanders, one forked for fish

be used for target practice or in hunting.

Now that you have your bow and arrows finished remember that you have a weapon in your hands and must use great care. Never aim it at any person. Do not aim it at an animal unless you intend to shoot. The "unloaded gun" is little more dangerous than the "unintentional shot" from a (Continued on page 75)

The Home Workshop

Arrows—What You Should Know About Them

(Continued from page 74)

bow. But used properly the bow and arrow is a beautiful weapon, which develops skill and accuracy and teaches one coördination of mind and muscle.

WHETHER you make your archery outfit as told in the July issue or buy it at a sporting goods store the first thing you will have to learn is how to string or brace the bow. Catch the lower end under your right instep, as demonstrated by Remington Schuyler on page 74. Then pull the grip or "hand" upward with your right arm and press down the upper end with your left arm, slipping the loop of the bowstring over the nock. Reverse the process to unstring the bow before putting it away.

If you find it more convenient, you can catch the lower end under your left foot and pull upwards with your left hand, slipping the loop off and on with your right. The principle is exactly the same, either way.

To shoot, fit the arrow nock to the string with the "cock" feather—the feather standing at right angles to the nock and usually colored differently than the other two feathers—pointing toward the left.

The first finger of the right hand engages the bowstring above the arrow nock, the second and third fingers are below. The arrow is gripped lightly between the first and second fingers but not pinched.

THE fingers should be protected with leather tips or a glove. These do not appear in the illustration on page 74 for the reason that Mr. Schuyler is one of the very few archers whose fingers are so hardened that they do not require this protection.

The shaft of the arrow rests on the left hand and against the left side of the bow, which should either be vertical or tilted very slightly toward the right at the top. The left arm is protected from the impact of the bowstring by a leather guard.

In drawing, keep the right elbow level with the shoulder and use the back and shoulder muscles. The arrow is pulled back until the point touches the left hand and until the forefinger of the right hand touches the jaw directly beneath the right eye. The right hand is always drawn to the same spot, the desired range is obtained by lowering or raising the left hand.

The feet are placed about 12 in. apart and the body is at right angles to the target, only the head being turned toward it.

The "loose" is accomplished by relaxing the right fingers and allowing the pull of the bowstring to straighten them out. No other movement is made until the arrow strikes its mark.

Always be sure the right forefinger is pulling hard and that the arrow does not creep forward before the release.

We Do Over Our Upstairs Rooms in

Sponge Stippling

By Berton Elliot, *Painting and Decorating Expert*

The flat face of the sponge is patted firmly on the wall without any turning or twisting

"IT BEATS all!" exclaimed Mrs. McAlister, from next door, to Mrs. Andrews, from down the street, who had dropped in to see our newly decorated upstairs rooms. And Mrs. Andrews replied, somewhat more conservatively, "I never saw anything like it before."

We had just finished decorating our four upstairs bedrooms and hall in sponge stippling, which work we had started after completing the downstairs decorating in "Tiffany" cloth stippling, as described in the May issue of Popular Science Monthly.

Paint stippling, at the time we did this decorating, had not come into very general use for home decoration, and the folks who called on us had never seen anything of the kind. Nowadays the finish is most popular, because of its beauty, its relative ease of application, and its durability and cleanliness.

FIRST we removed the wall paper by saturating it thoroughly with warm water and scraping with a putty knife. This finished, we were ready to start the stipple treatment.

Sponge stippling is done by applying a background coating of flat wall paint of the desired color, over which one or more stipple color coats are applied with a sponge. The secret of success lies in a harmonious combination of colors, together with a few important details of mechanical execution that will be explained further along.

Stippling provides texture in wall decoration, an element that has long been an "open sesame" to charming effects in dress. The texture of the stippled wall is very much the same in principle as that of fabrics—the subtle weaving in of bright bits of color to produce a neutral and sufficiently conservative tone. In wall decoration, the bits of color are woven in by the stippling process.

Either the foundation coating can be in a rather bright color and a stipple pattern applied over it in a neutral color to tone down the background, or a neutral color may be used to start with and the bright color woven in with the stippling sponge. The whole effect resembles tapestry or brocaded satin, while actually the wall is smooth and correspondingly easy to wash and clean.

IN OUR little home decorating operation, we had selected for the first room a cream foundation color, stippled with ivory, with a second stipple color of soft cream-gray over the first stipple—a combination chosen to give our north bedroom a warm sunshiny atmosphere, and also to make a somewhat small room seem larger.

The foundation or background coating was first applied to the wall—two coats of regular flat wall paint in cream color, applied with a 4-in. flat wall brush. The first coat was mixed with an equal part of a varnish mixing size, to seal the very porous plaster and keep the paint from sinking in.

The ceiling was done at the same time—three coats of ivory white, to be left in plain color.

In this room, which contained the chimney, the settling of the house had cracked the walls and ceiling quite badly. After the first coat had been applied, these cracks, as well as all holes and imperfections in the plaster, were filled with a mixture of plaster of paris and the wall paint, knifed on smoothly with a putty knife. There were also some places where the woodwork did not fit snugly against the walls. These cracks were filled with the same mixture.

No more work was done on the walls until the next day, as painting over the wall before these spots had dried hard would be likely to result in the paint's sinking in, producing a spotted finish. We then applied the second coat of cream wall paint, and were ready for the stippling.

Loading the sponge with the stippling color some of which was poured on a piece of tin

A sample of sponge stippling one half full size and a greatly reduced view of the sponge

As previously indicated, the pattern, or more correctly the texture, of the sponge is printed onto the background color. In selecting the sponge, an expensive one is not necessary, but one with an interesting pattern, having well defined open spaces of a delicate, lacy nature. The bottom of the sponge is trimmed or sliced off to get a perfectly flat printing surface. This may be done by soaking the sponge in warm water and trimming with a pair of shears, or by cutting the sponge with a large knife when dry. This is one of the secrets of sponge stippling, as unless the printing surface is perfectly flat, only the high spots will print. When ready to start stippling, the sponge is wet in water to soften and open it up, and wrung out moderately dry.

IN DOING the first stipple coat for our north room, some of the mixing size used in the first coat for sealing the wall was added to the ivory stipple color in the proportion of one part size to three parts paint. The addition of the mixing size was to give the bits of stipple color a delightful sheen when dry, instead of the dead flat finish of wall paint. A little of the mixture was then poured out on a piece of tin.

The sponge was rubbed into this mixture and tapped a few times on a piece of clean paper to remove any excess paint. The stippling then was started by patting the sponge straight onto the wall, without turning or twisting, and with a firm but not too heavy stroke. After every fifteen or twenty strokes the sponge had to be reloaded.

Another secret (Continued on page 77)

The Home Workshop

We Do Over Our Rooms

(Continued from page 76)

of stippling is to have the right amount of paint on the sponge. Too much will produce a heavy, dauby print, and too little will make weak, uneven prints. Avoid placing the sponge prints in straight lines—stagger the prints as you go along, being careful that each print comes closely up to the one next to it, but not overlapping.

A little practice work should be done by the amateur on sheets of manila paper. It is also well, at all times, to start back of a door or some other less conspicuous surface so you can be sure everything is running along right when you get to the more conspicuous parts of the wall.

AFTER going clear around the rooms, a small piece cut from the back of the sponge was used to get into the corners and do the edges next to the woodwork and ceilings. It is a good plan also to have a piece of tin or cardboard which can be held against the woodwork or ceiling to keep from daubing them, and any daubs should be wiped off quickly while the paint is fresh.

The sponge, of course, was thoroughly rinsed out in gasoline, followed by a soap and warm water washing immediately after finishing the stipple coat. If done at once, there is no difficulty in washing it out just as clean as before starting.

The next day we went over the room again with the cream-gray stipple mixture. While a two-color stipple always looks much more attractive than one color, it is really easier to do well, as the second stipple tends to cover up imperfections in the first stipple coat.

The stippling completed, a stencil border was applied to add the necessary finishing touch.

The other rooms were then done in the same way. In one a silver gray foundation color was used, with a first stipple coat of pink, and an over-stipple of ivory tan. In another room a silver gray foundation color was used with a first stipple coat of sage green, over stippled with a mixture of silver gray and ivory.

IN THE hall a rather neutral effect was used and one also that would show hand marks to the least—a silver gray foundation color, stippled first with blue-gray and warmed up with an over-stipple of ivory.

In each room one of the stencil colors was spotted on fixtures and lighting brackets, and the use of golden glow light globes further improved the effect.

Paint stippled walls have a richness and depth of tone that lift them out of the ordinary, and at the same time are a most practical form of decoration, as they can be washed repeatedly without injury.

Spools of wire, which have a habit of unrolling when thrown into a bench drawer or tool chest, can be kept neatly on a common ten-cent curtain rod fastened under one end of the bench. Metal linoleum binding can be screwed to the back of the bench to form a light tool rack.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Real Speed *in a* Yacht Model

An Easy Way to Build a Small Boat That Will Win Races—Has Self-Acting Tiller

By CAPT. E. ARMITAGE McCANN

NOW that the hull of our 60-in. yacht model is made, we can turn our attention to the much easier work of adding the accessories and getting her ready for her first sail.

Perhaps you missed the beginning of this article, which appeared in the July issue. If so, you can obtain the essential information for building the hull from Home Workshop Blueprint No. 48 (see the list on page 81). A copy of the July issue also can be had, as long as a supply is available, by sending twenty-five cents to the circulation department.

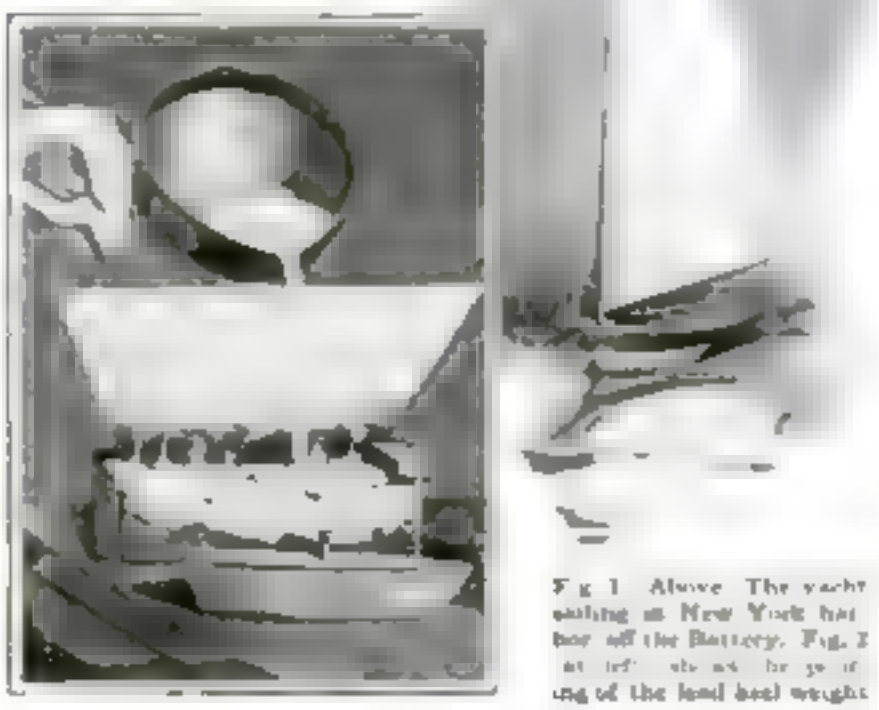


Fig. 1. Above: The yacht sailing in New York harbor off the Battery. Fig. 2 at left: showing the pouring of the lead keel weight

The keel (Fig. 3), of aluminum or galvanized iron, had better be made next. It is a good idea to take a paper pattern of the keel to a tinsmith and let him cut it from a sheet of No. 22 gage galvanized iron. It is about ⅛ in. thick, 10 in. along the top, 4½ in. at the bottom, and 5 in. deep. Beyond this measurement about ½ in. additional should be left at the top and bent to a right angle, with six holes drilled and countersunk for ½-in. brass screws.

On the bottom there is molded enough lead to make the whole keel weigh about 1¾ lbs. First make a wooden pattern, boat shaped, 1 in. high, 1 in. across the top, and ¾ in. across the bottom (Fig. 2). Put a wood screw in the top to hold it.

Fill a small box with plaster of paris and water. Sink the pattern, previously oiled all over, in it and allow the plaster to set. Remove the pattern, and thoroughly dry the plaster, placing it in a slow oven if you are in a hurry.

Make a saw cut in a slip of wood and tack it so that the cut stands over the fore end of the opening in the mold for a distance of about ¼ in. to serve as a clamp for holding the sheet metal in place while the lead is being poured (Fig. 2). Next bore a couple of holes in the keel to act as keyways for the lead to flow into. Thoroughly clean the metal and set it dead upright in the center of the mold. Melt about 1½ lbs. of scrap lead in a ladle (an old aluminum saucepan will do) and pour it into the mold, *from both sides*, so as not to buckle the sheet metal with the heat. When cold, remove and trim smooth, making sure that there is the same amount of lead on each side. Give the whole a couple of coats of paint or enamel to match the hull and lay to one side for the present.

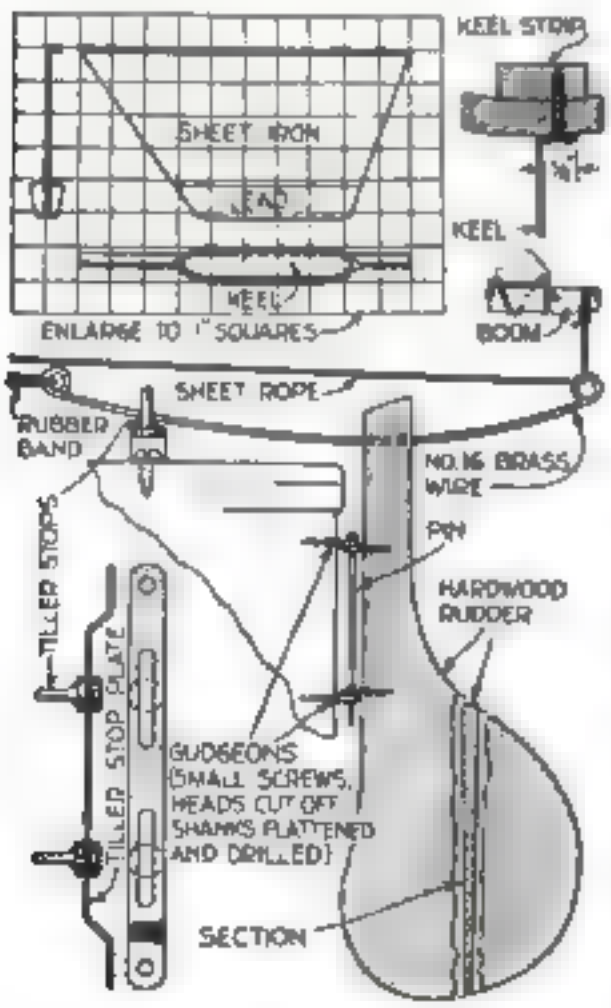


Fig. 3. The keel and the automatic tiller control. Rudder is moved by sail to suit the wind

THE mast, Fig. 7, can be made from a straight grained ½-in. dowel stick, tapered to ⅜ in. at the top. It will be 34 in. long over all. Cut a slight groove around it 24 in. from the heel and bore a small hole 1 in. from the top. Insert a small brass or nickel screw eye ⅜ in. from the heel (that is, ⅜ in. above the deck). All exposed screws or screw eyes should be of brass or nickel-plated brass.

The boom is a ¼-in. dowel stick, 20½ in. long, tapered to ⅜ in. Slightly open a screw eye and screw it in the thick end. Bore a hole 1 in. from the other end and make a groove for the sheet (line) ¾ in. from the end.

The bowsprit is a ¼-in. dowel 4¾ in. long. Taper the outer end slightly and flatten the inner; 3 in. goes outboard. It has a screw eye in the extreme end, and a cleat is screwed to it for the sheet. This cleat is a thin, smooth piece of metal screwed down in the middle, the ends being raised a trifle.

It looks better on the deck, but it is handier here.

The spars should be polished with shellac or oil or be given a coat of varnish.

The mast step (Fig. 6) is a piece of ⅜ or ½ in. thick wood, about 1¾ in. square. It has a ½-in. hole in the middle to fit the mast snugly and is firmly glued and screwed to the deck, with its center 2¾ in. from the bow.

There are several devices by means of which the mast can be moved forward or aft to adjust the sails to the wind force. This is a fine idea and works well with a fixed rudder, when the wind is steady. It is the writer's experience, however, that it is only a sea breeze that is steady in force and direction, and that on ponds and other inland waters the wind constantly varies.

THE only device that approximates the man at the helm of a real craft is, therefore, a self-adjusting rudder. The simplest of these is one hanging loose and weighted on the end, so that as the boat heels over she gives herself more helm. A quicker and more positive action is the one shown in Figs. 5 and 4. The ideal, of course, is both an adjustable mast and an automatic rudder.

But first the rudder must be made and hung. Any scrap of hardwood ⅜ by 2 by 4½ in. will do. Cut it to the shape shown, taper the fore edge from the lower gudgeon to almost nothing at the bottom and the after edge from about the upper gudgeon, making the whole of the lower half quite thin.

Fig. 4. The wind automatically pulls rudder to leeward against tension of the rubber band

Four gudgeons are needed. These may be small screw eyes, but can better be made from small screws with the heads cut off and the shanks flattened and drilled. They can be bought ready made.

It may be pointed out parenthetically here that entire construction sets containing the materials for a yacht of this general type can be purchased at almost any well stocked toy shop or large department store.

(Continued on page 79)

Speed in a Yacht Model

(Continued from page 75)

Screw one of the gudgeons in the fore edge 1¼ in. from the top of the rudder, another 1 in. below that, and place the other pair in the stern of the boat so that they will come just above and below the first two, when the head of the rudder projects about ½ in. above the deck. A long pin or a piece of wire with the end bent over is passed through the gudgeons to hang the rudder, which must swing freely and be as close to the stern as possible.

Now place an opened screw eye in the deck just abaft the hatch. Drill a hole

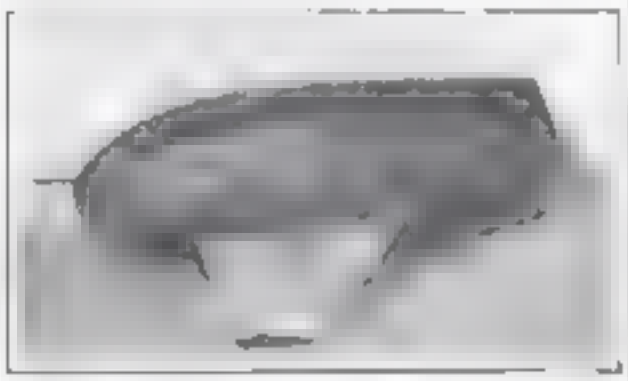


Fig. 5. Under view of the hull before being painted, with heavy keel and rudder in place

through the rudder ½ in. from the top. Through this force a piece of No. 16 spring brass wire and bend it up a little on both sides; 1¼ in. from the after edge of the rudder bend the wire around to an open ring, and 2½ in. from the fore edge, into a hook (Fig. 5).

WHEN the boat is to be sailed, a rubber band connects the forward end of the tiller and the hook in the deck. The pull of the elastic tends to keep the rudder straight. The main sheet from the end of the boom passes through the outboard eye and to the cleat forward. The more wind there is, the more the sheet pulls the rudder to leeward, thus correcting the pressure of the water on the lee bow, which is just what a helmsman would do. The proper tension of the rubber band has to be determined by actual test.

That the rudder may not go too far over, a stop is required, and this has to be adjustable because the yacht will need more helm under some conditions than under others. A strip of wood across the stern with holes and pegs will serve for this, but somewhat neater is that used in the example (Figs. 3 and 4). It consists of a strip of brass raised in the middle and screwed to the deck at the ends, with two slots in it. In these slots run two radio switch stops.

The sail (Fig. 6) requires careful making. Balloon cloth is the best material, next come soft finish cambric, linen obtained by washing out tracing cloth, or thin treasure. If none of these can be had, use any thin, good linen. Shrink it before cutting.

The luff (mast edge) will be 31 in., the foot 19½ in., and the leech 35 in. The latter should be parallel with the selvedge of the cloth.

The luff and the foot do not form quite a right angle, so (Continued on page 80)

The Home Workshop

Real Speed in a Yacht Model

(Continued from page 79.)

that the boom will be raised a little. The leech is not straight but bows out in what is called a roach. The other edges, in a sail of this size, may be straight, although the luff may have a little roach.

A templet should be made and pinned on the cloth before marking and allowance made for a ½-in. hem along the luff and foot and as small a hem as possible on the leech.

Take an 8-ft. length of thin cord such as 24-lb. fishing line knot one end, stitch it to the clew (lower aft corner of the sail) and sew it inside the hem round via the tack (lower fore corner) to the head, stitch it there. When the sail is set take the line through the hole bored in the mast, hitch it round the mast, and carry it down to the bowsprit end as a stay.

Sew two pockets on the after leech, as shown (Fig. 6) and in them insert strips of celluloid or whalebone, 4½ and 5 in. long, each about ¼ in. wide.

Hook the boom to the mast and, starting at the tack, stitch the sail to boom and mast with crochet cotton. Be careful not to stretch the sail when sewing or binding it to the spars and see that the tack comes right to the mast.

Put screw eyes in the side planks about 5 in. in from the bow on either side. Tie another piece of cord to the groove on the mast to come down on each side some 4 in. beyond these eyes.

Meanwhile, give the brightwork (varnished wood) and the enamel a final finish with rottenstone and water, so that the yacht is smooth and sleek without being glassy in appearance.

SCREW the keel to the hull, with the after edge 3½ in. from the stern, but first enamel the edge and touch the paint up afterwards. Be sure that its center line coincides with the center line of the boat. Try it in a bath of water to see that it floats upright; if not, it may be that the flange of the keel needs bending slightly.

To set up the mast, step it in the hole. Make three toggles (Fig. 6) from thin pieces of celluloid or metal with three holes in each, and make three ring hooks. Reeve the forestay through the two top holes of a toggle, through a ring hook and back to the other hole in the same toggle. Hook to the spar end and set up tight; it is exactly like setting up a tent rope. Do the same with the two backstays and see to it that the mast is dead upright when the boat is afloat.

Fasten a similar piece of line to the end of the boom, reeve it through the ring in the reverse tiller and fasten to the cleat on the boom. The amount of slack to give the sheet depends on how the boat is to sail with reference to the wind. That is a matter of experience but, roughly speaking, the more the wind is behind, the more sheet she will need.

There are many ways of building a stand for her. The folding stand in Fig. 6 is merely a suggestion. If you want one, you can use your ingenuity, but be careful not to put a strain on the keel at any time.

The yacht is now ready to launch—to respond to the lightest breath of air or boom along in the stiffest gale. Go to it, and luck attend your efforts!

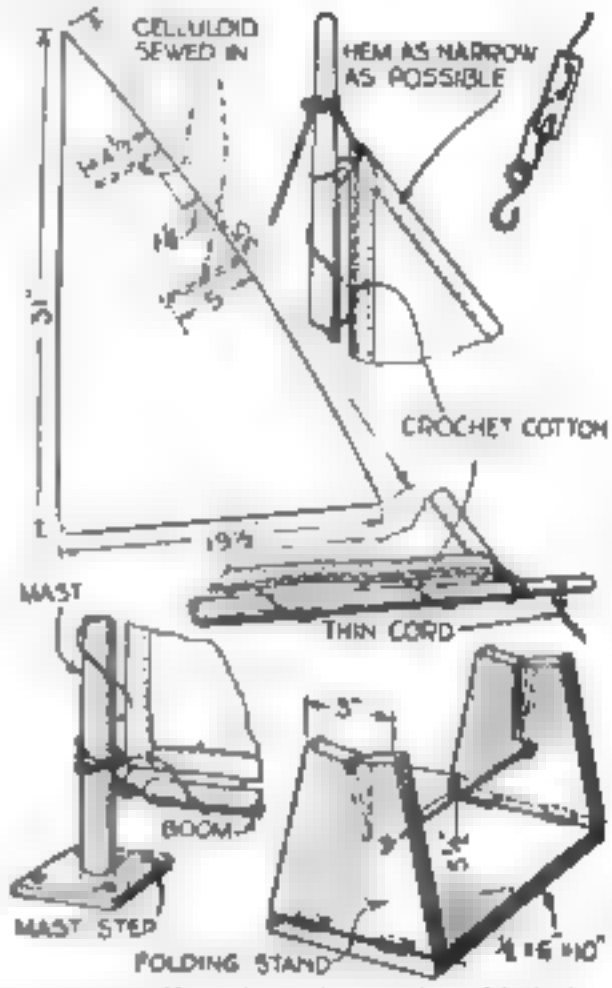


Fig. 6. How the sail is made and lashed in place; a stay toggle and a folding stand

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THE thousands of readers who have found enjoyment in making the POPULAR SCIENCE MONTHLY models will be interested in two articles scheduled for next month, one an airplane model, the other a miniature rotor yacht. Those who have not yet built a decorative model for their homes should not overlook the two remarkable ships represented in the Home Workshop blueprints Nos. 44 to 47. These are listed on page 81.

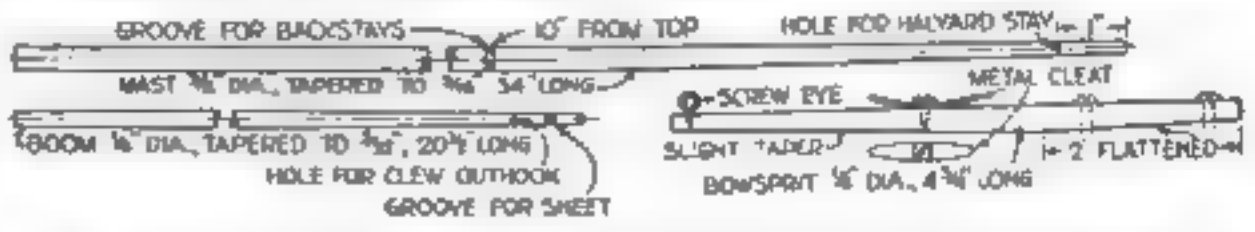

Fig. 7. Details of the mast, boom and bowsprit. The first is made from a ⅝-in. birch dowel; the other two are ¼-in. dowels. The bowsprit is one of the most convenient places for tying the sheet

Blueprint Gives Designs for Garden Trellises

AFTER school hours John Mitchell, of Point Pleasant, N. J., a young reader of POPULAR SCIENCE MONTHLY, built this imposing rose trellis. He followed a design shown in Home Workshop Blueprint No. 34 in the list below. Several other designs for architectural trellises are given in that blueprint, together with details and bills of material.

Complete List of Blueprints

ANY ONE of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I enclose ..... cents

No.	Title	Published	Price
1.	Sewing Table	Feb. '33	25c
2.	Smoking Cabinet	Mar. '33	25c
3.	End Table	Apr. '33	25c
5.	Kitchen Cabinet	May, '33	25c
6.	Shaving Cabinet	June, '33	25c
9	Arbor, Gate and Seats	July '33	25c
10.	Porch Swing	Aug. '33	25c
11	Bench and Tilt Table	Sept., '33	25c
12.	Electric Washer	Oct. '33	25c
13	Tea Wagon	Nov., '33	25c
14.	Christmas Toys	Dec. '33	25c
15	Workshop Bench	Jan. '34	25c
16.	Inlaid Radio Cabinet	Feb. '34	25c
17	Cedar Chest	Mar. '34	25c
18.	Phone Table and Stool	Mar. '33	25c
19.	Grandfather's Clock	Apr. '33	25c
20.	Flat Top Desk	Apr., '33	25c
21	Colonial Desk	Apr. '33	25c
23.	Cabinet and Desk	Apr. '33	25c
33.	Pergola Garage	May '33	25c
24	Gate eg Table	June, '33	25c
25	Canoe Sailing Outfit	July '33	25c
26.	Baby's Crib and Pen	Sept. '33	25c
27	Kitchen Cabinet Table	Oct., '33	25c
28.	Pullman Play Table	Nov. '33	25.
29.	Toy Tea Cart etc	Dec. '33	25c
30.	Tool Cabinet etc	Jan., '34	25c
31	Sewing Cabinets	Feb. '34	25c
32.	Chinese Game Table	Mar. '34	25c
33	Dining Alcove	Apr. '34	25c
34	Garden Trellises	May '34	25c
35	Simple Radio Cabinet	Oct., '34	25c
36	Rush Bottom Chair	Nov., '34	25c
37	Simplified Bookcase	Dec., '34	25c
38	Sheraton Table	Jan. '35	25c
39	Salem Chest	Feb., '35	25c
40.	Desk in Sheraton Style	Mar., '35	25c
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42	Three-Stage Amplifier	June, '35	25c
43	Four Tube Receiver	July '35	25c
44	Pirate Ship Model Hull	Feb., '36	25c
45	Pirate Ship Details	Mar. '36	25c
46.	Galleon Model Hull	May, '36	25c
47	Galleon Model Details	May '36	25c
48.	Sailing Yacht Model	July, '36	25c
49.	Broom Cabinet	Aug., '36	25c

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This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Thrills in Water Scooting

(*Continued from page 70*)

Then screw the side pieces to the stern piece with two 1¼-in. brass screws at each end. After fastening N and N¹ Fig. 2) mark the front ends of pieces M and M¹, as in Figs. 2 and 3, locate the bow piece K by measuring 6 ft. 8 in. from stern to bow on the center line.

Fasten the bow piece with a screw on each side at the point marked AA, Fig. 3. Make a saw cut at CC, which will remove the overlap BB, thus making a perfect fit between K and the side pieces M and M¹.

Bore a ⅜-in. hole down into the joint CC and fit in a dowel tightly. The dowel aids in making the joint watertight. Nail an extra reinforcing piece P (Fig. 2) to the inside of the bow.

The molds C, D, E and F now can be fastened in place with a 1¼-in. brass screw on each side. When trimming molds G and H to fit, make sure that the notches line up with those of the other molds. Finally, fasten mold J with one screw at each end, driven at an angle, as shown in Fig. 2.

Next comes the ribbing L. It may be possible to obtain this material, ⅛ by 1 in. strips, preferably ash, already cut at a woodworking mill. If not, endeavor

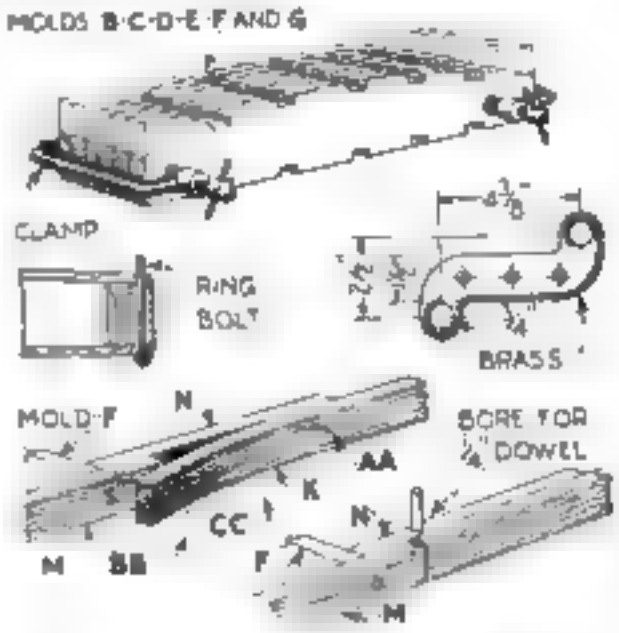


Fig. 3. The molds clamped together for marking and cutting; how to make a seat harness fixture from brass, and other details

to have the mill or some obliging carpenter cut them for you on a machine saw. Ten lengths, each about 6 ft. 8 in. long will be required. Fit the ribbing in the notches and screw to the molds with heavy 1¼-in. brass screws. Trim them off at the bow and nail in place.

To drain off any water that may enter the interior, fit a plug in the stern, as shown in Fig. 1. A sound cork will serve as a plug, or a small valve or pet cock can be fitted.

The harness fixture shown in Figs. 1 and 3 is cut from a piece of ⅛-in. brass and filed to shape. Two are needed, one being the reverse of the other. Fasten these with three heavy 1¼-in. brass screws. As an alternative, two ring bolts 3 in. long placed 4 in. apart may be used, as shown in Figs. 1 and 3.

For the deck and hull sheathing use ⅛-in. basswood, if obtainable. Twelve strips are needed, varying in width from 3⅝ to 5 in. The 5-in. pieces are pared at the outside edges; the extra width makes the necessary trimming easier. They are trimmed, of course, after being fastened in place.

Before fastening the sheathing, plane the frame sides M and M¹ and the bow piece K to conform with the slope of the deck. Cross sections of the parts A, A², and A³ in Fig. 2 are shown in Fig. 5.

Then lay strips of cloth, previously soaked in linseed oil, on top of the ribbing L. This will insure the joints being as watertight as is necessary. Nail the sheathing in place (*Continued on page 84*)

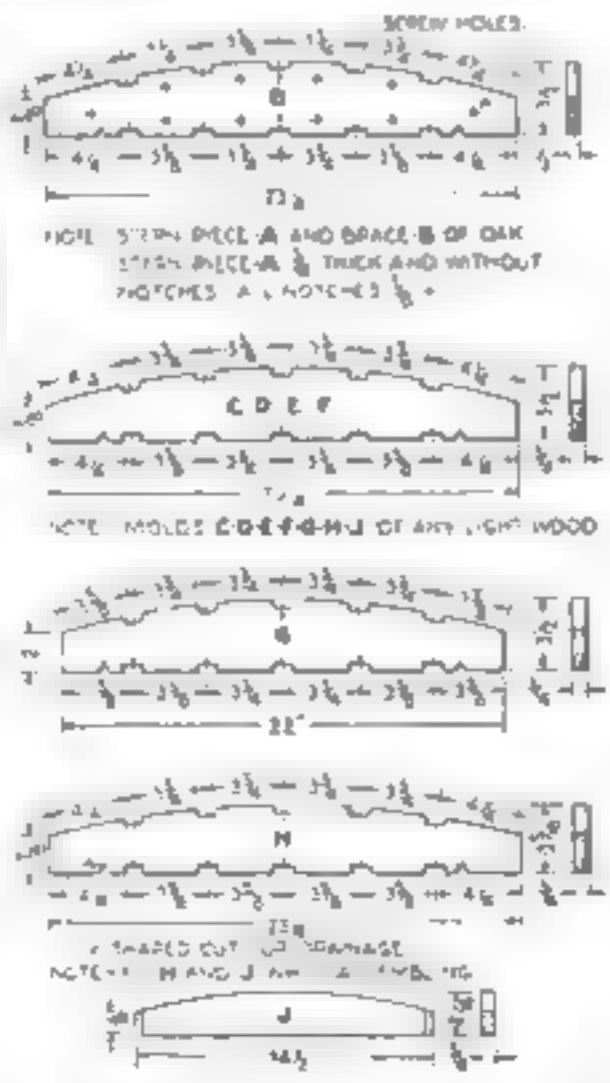


Fig. 4. How the cross pieces are laid out and cut. The rectangular notches are ¾ in. deep. The triangular ones are merely for drainage. The lower diagram shows how to lay out the bow piece

The Home Workshop

How We Built a Temporary Silo for $47.50

FARMERS who find themselves short of space for storing ensilage can build an outside bin at surprisingly low cost.

We tested the idea on my farm last fall and did not have any mouldy or spoiled silage. The entire cost for materials to make a bin 14 by 14 by 14 ft. was only $47.50.

We used ordinary ship lapboards and two by fours. The latter were placed 3 ft. apart on the outside to serve as studding. The walls were erected as we filled the silo. Common eightpenny nails were used and they were not driven all the way in, as we intended to take the bin down as the silage was fed out.

This bin for ensilage was built as it was filled; no roof was provided, but the top of the ensilage was covered with a foot of chaff and short straw

Close to the bottom of the studding, on the outside, we laid a pole and then drove pegs into the ground to keep the bottom from spreading. At the top we wired the studs together and also used a few braces placed against the middle of the studs. If two by sixes had been used this extra bracing would not have been necessary. The side pressure, however, is not very great; it was less than we expected.

It is important to pack the silage in well, as there is less height and consequently less pressure than in a modern silo. Our corn had been shocked about a month before it was put in, so, of course, we had to use plenty of water. The top of the silo was covered with about a foot of chaff and short straw.

Several silo owners who saw our silage said that it was equal to any in the county.—WILLIAM SMITH.

Thrills in Water Scooting

(Continued from page 80)

Bill of Materials

No. Pcs.	T	W.	L.	Part and Material
1	¾	4	24	Stern piece A, oak
1	¾	4	21	Arrow B, oak
1	¾	4	144	Molds for C D E F G, H any wood
1	¾	3	16	Mold I, any wood
1	¾	3	144	Side M and K, oak
1	¾	2	96	Side M and between N and N, oak
1	¾	3	24	Bow piece P, oak
10	¾	1	80	Ribbing I, ash
4	¼	5½	80	Sheathing, basswood
8	¼	4	80	Sheathing, basswood

Heavy brass screws 100 1¼ in. long 20 ¾ in. long 6 1 in. long and 1 ½ in. long; ¾ lb. copper nails; 1 lb. galvanized iron nails; one glass bottle, ¼ by 3 by 13 in.; four galvanized eye bolts 3 in. long; strips of rich oil paint and varnish.

All dimensions are given in inches

with ¾-in. copper nails except at the molds and around the outside frame, where 1 in. galvanized iron nails are needed. Drive a 1¼-in. brass screw through the center of each sheathing strip at each mold crossing, as shown in Figs. 2 and 6. As the sheathing strips are fastened in place, it is desirable to give each a coat of linseed oil or to paint them.

It is obvious that a much easier bow to build is the square one shown in Fig. 1. If difficulty is experienced in obtaining long pieces of clear wood for the sheathing, shorter pieces can be used, as indicated in Fig. 1 by running them crosswise with joints at the molds.

When the deck and bottom have been trimmed off, sandpaper the scooter smoothly, round the edges, and apply

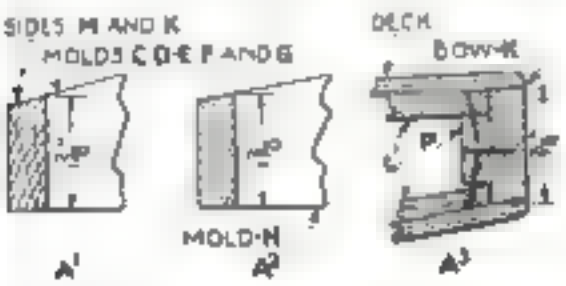


Fig. 5. Two sections through the edge of the scooter and one through the bow. Compare these details with those shown in Fig. 2.

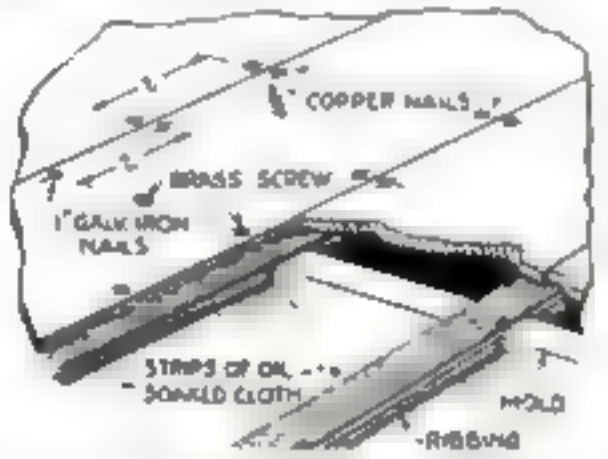


Fig. 6. A part of the deck showing how the sheathing is nailed and screwed to molds and ribbing with cloth strips, oil soaked, at seams

two coats of outside oil paint. Sandpaper the last coat lightly and apply a coat of spar varnish.

As for colors, the builder can suit his own fancy. A bright vermilion with yellow and blue striping is a favorite combination.

Resurfacing Old Oilstones

AT THE shop and about my home, I had several old oilstones, the surfaces of which had become so pitted and worn as to be next to useless. To true them up, I sprinkled a handful of fine sand upon a level piece of cement floor, added enough water to make a thin paste, and rubbed the oilstones face down on the concrete with a circular motion. A level surface could be obtained in this way, I found, much more quickly than by using a lapping block with oil and emery dust.—STANLEY S. DE WITT.

The Home Workshop

How to Shape Curved Edges

Preparing Ornamental Tops for Furniture

By EMANUEL F ERICSON, *Noted Manual Training Authority*

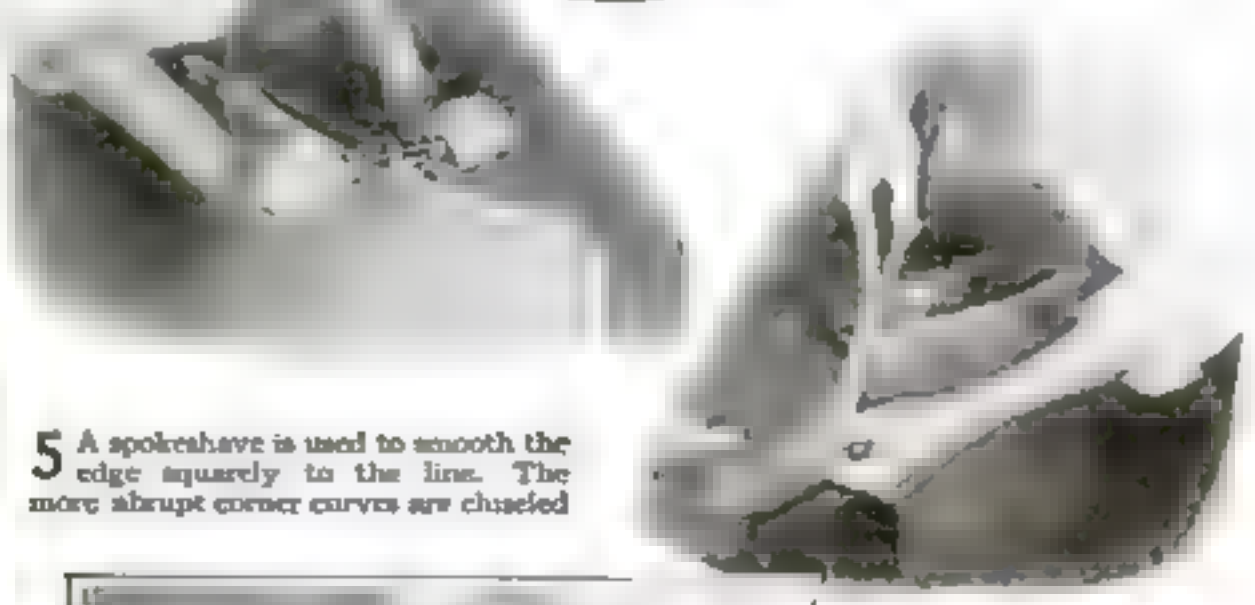
By shaping a table top or similar part gracefully the beginner in woodwork can give a distinctly professional look to the furniture he builds

1 Draw a full size paper pattern of the top or other part. Then trace carefully around the edges of the pattern with lead pencil

2 Make a series of saw cuts from 1 to 1½ in. apart, cutting down to within ⅛ in. of the outline. Hold the saw level when approaching the line

3 Cut away the waste wood roughly with a chisel or drawknife

4 (Left) A quicker method is to use a compass or keyhole saw to remove the waste wood to within ⅛ in. of the pencil line



5 A spokeshave is used to smooth the edge squarely to the line. The more abrupt corner curves are chiseled

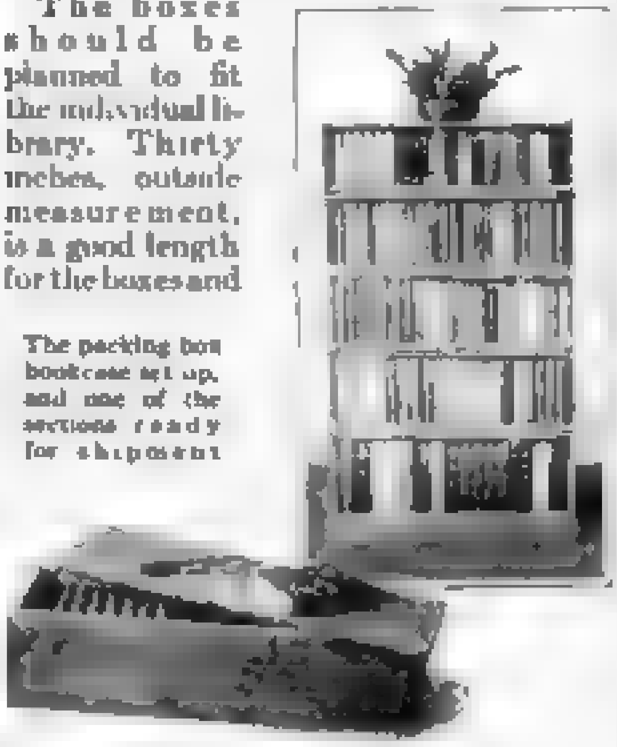
6 For smoothing the curve on the corners, use a wood file. The stroke is parallel to the grain with a continuous forward motion

7 Do the final smoothing with sandpaper folded tightly over a block that is slightly rounded underneath

Packing Boxes Converted into Sectional Bookcase

UNIFORM packing boxes, if made especially to fit a row of standing books, may be converted into sectional bookcases by those who travel about or move frequently. A stack of the stained boxes set up on a few cover boards as a base makes a presentable appearance. For shipping, it is necessary only to fasten on the lids with screws. The books are already packed.

The boxes should be planned to fit the individual library. Thirty inches, outside measurement, is a good length for the boxes and an outside depth of 7¼ in. will accommodate all ordinary books.



The packing box bookcase set up, and one of the sections ready for shipment

The width of the boxes will vary with the binding of the volumes, boxes of three different widths will suffice for the usual private collection of books.

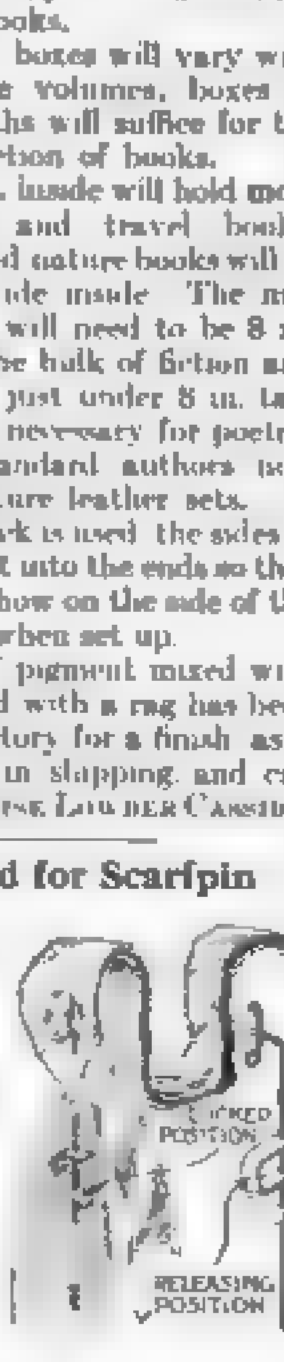
A width of 9½ in. inside will hold most reference, science and travel books. Children's books and nature books will fit in a box 8½ in. wide inside. The majority of the boxes will need to be 8 in. wide inside, since the bulk of fiction and sets of classics are just under 8 in. tall. A 7-in. box may be necessary for poetry, gift books and standard authors now published in miniature leather sets.

Lumber ⅝ in. thick is used, the sides of the boxes being inset into the ends so that the joints will not show on the side of the sectional bookcase when set up.

A simple stain of pigment mixed with gasoline and applied with a rag has been found to be satisfactory for a finish, as it will not scar badly in shipping and can be renovated.—LOUISE LOUDER CASSIDY

Spring Guard for Scarfpin

A SCARFPIN guard may be made of a ⅛ in. wide piece of thin spring steel having a hole the size of the scarfpin or slightly larger punched in each end. The ends are pressed together to slip the guard over the pin.—W. J. E.



The Home Workshop

You Need Only a Pocketknife to Make These Block Puzzles

By Arthur L. Smith

BLOCK puzzles may be made with more or less blocks than those described in an earlier article (March, 1930, issue) and combined into different forms. The cuts also may be varied, making the puzzle either simple or intricate.

In the two following examples simplicity is the aim, rather than intricacy. Both are made of blocks ¾ by ¾ by 2 in., though they may be of any convenient size. There is one plain key block. In the others the cuts are all ¾ in. deep and ¾ or ⅜ in. long (with the exception of *D* which has a cut 1⅜ in. long) and all cuts are started ¾ or ¾ in. from one end or the other. The manner of making the cuts is clearly shown in the illustration. Two views of block *F* are given.

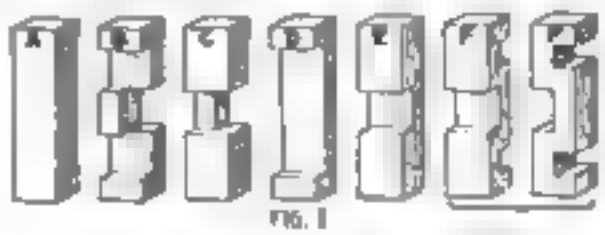


FIG. 1

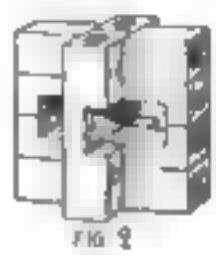


FIG. 2

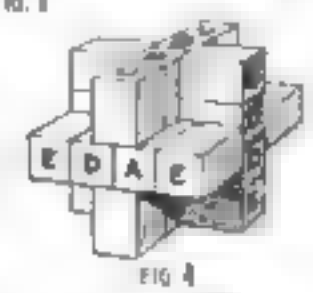


FIG. 4

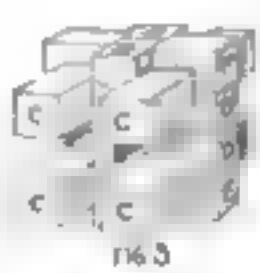


FIG. 3

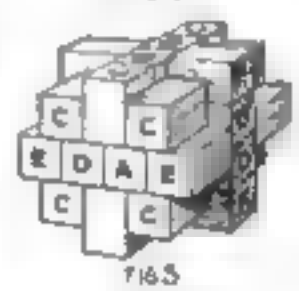


FIG. 5

Two puzzles, one containing 12 and the other 16 blocks, and steps in assembling them

Figure 4 shows a puzzle assembled of twelve blocks: *A, B, B, C, C, D, D, D, E, E, E*. To form the combination in Fig. 5, sixteen blocks are used: *A, B, B, C, C, C, C, C, C, D, D, D, E, E, F, F*.

It is rather difficult to describe clearly the assembling of these puzzles, but an idea may be given. For the twelve-block puzzle (Fig. 4) first take a block *B* and lay it down with the two cuts facing you exactly as in Fig. 1. Then take *D* and *E* placed back to back and put them in the upper ¾-in. cut on *B*, with *E* at the top. Take another *D* and *E*, back to back, and put in the lower ¾-in. cut on *B*, with *E* at the bottom. Take the second *B* block and place over this combination so that the two *B*'s bind *E, D, D, E*. Figure 2 shows the combination at this stage.

Push the two *D* blocks to the left sufficiently to admit another *D* and *E*, back to back in the slot, with *E* on the outside. Push the *D*'s back to position. Two *C* blocks are now put in the grooves that will be seen for them, one on each side of a *B*. A slot ½ by ¾ in., which can be seen in Fig. 2, is still open. The last *A* is inserted in this slot with the ½-in. cut uppermost. When this cut engages the ends of *D, D*, a ½-in. square hole is left for the insertion of block *A*.

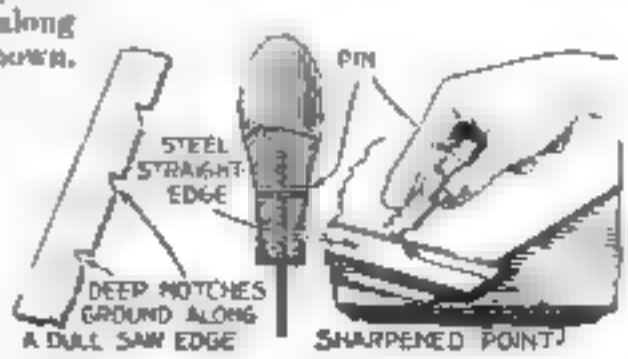
The sixteen-block puzzle is fitted together in the same way except that instead of using *D* and *E* back to back for placing in the ¾-in. cuts on *B*, the block *F* is used instead of *E*. A *C* block is fitted into each ¾-in. groove on *F* so that the sides of *C* are ¾ in. from the end of *F* and ¾ in. higher. Thus two cuts are left into which *D* may be placed. Figure 3 shows this combination after the second *B* block is placed. While the two *D* blocks are out of place for the insertion of *D, E*, the two additional *C* blocks must be put into position before the *D*'s are pushed back.

This by no means exhausts the subject of block puzzles. Longer blocks may be used and ingeniously fitted together to make various designs.

How to Make Use of Worn-Out Hacksaw Blades

IF YOU have a rush job and find that you have only one hacksaw blade at hand and that a dull one, you probably can make it cut by grinding several gashes along the cutting edge, as shown. Be careful, however, not to ram the blade into the wheel, as the heat generated would anneal the blade and make it useless.

From discarded blades many useful tools can be made. One is a glass cutter, which can be made from the end portion of an all-hard blade. The cutting point must be ground sharp.



One way to "revive" temporarily a dull hacksaw blade; a glass cutter made from one

The writer often has used blades for shimming up work strapped to a planer or shaper table. On one occasion when a small washer was needed, the end or "eye" of a discarded hacksaw blade was broken off and utilized.—C. M. Wilcox.

A SERVICE FOR YOU

In Buying Radio & Tool Equipment

For list of tested and approved products write to the Popular Science Institute of Standards. See Page 6.

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

MERCURY is the only metal element that is liquid at ordinary temperatures. It conducts electricity and expands uniformly when exposed to heat; it is employed in thermometers, barometers, manometers and finds use in the extraction of gold and silver. Small quantities may be obtained in some drug stores, but it is more economical to purchase it from chemical supply houses.

One of the greatest uses of mercury in the shop is as an amalgam for strips or cylinders of zinc to be used in primary wet batteries. The zinc is first cleaned with dilute sulphuric acid, ten parts of water being used for each part of acid (pour the acid into the water very slowly). Moisten absorbent cotton with dilute sulphuric acid, dip it into a few globules of mercury and rub the zinc until a very thin film of mercury covers the surface. This makes the zinc last much longer.

One way of bending zinc before amalgamating it

A plastic metal amalgam suitable for soldering without a soldering iron can be prepared by uniting copper and mercury. Mix two or three parts of pure copper dust or powder, after thoroughly moistening with a solution of mercuric nitrate, with seven parts, by weight, of mercury, to which a little hot water has been added, and knead the mixture together by means of a mortar and pestle, keeping the latter in a dish of hot water.

The copper amalgam also may be used to obtain casts of such delicate things as plant structures, grasses, ferns, or even cuts and engravings. It is pressed on the substance and left for a few hours.

To use it as a solder, clean the parts to be united and heat them to a temperature just below that of boiling water. Rub the amalgam over the hot surface, press together the metals to be united, and set aside for twenty-four hours. Such parts must not be exposed to heat.

Vapors of mercury are poisonous, but used with care mercury itself is harmless.

Paste the following label on your bottle of mercury or file it for reference:

Quicksilver
(Mercury) Hg.

Keep in tightly stoppered bottle. To amalgamate zinc, moisten a clean rag with dilute sulphuric acid, dip into a drop of mercury and rub the zinc. When zinc to be used for batteries is treated in this way, it will last about twice as long as untreated zinc.

To make an alloy that is very hard at ordinary temperatures yet may be softened in hot water, mix two or three parts, by weight, of powdered copper which is first moistened with a solution of mercuric nitrate in water, with seven parts, by weight, of mercury and rub together until uniform in consistency. The greater the quantity of copper powder used, the harder is the amalgam.

An Easily Made Smoking Cabinet

EVERY man who works with tools—whether he is a novice or a "handyman" with long experience—will find it easy to build this handsome smoking cabinet.

Space for cigars, cigarettes, match boxes, cigar and cigarette holders and pipe cleaners are provided. A feature that every smoker—and his wife—will appreciate is the ash receptacle and the removable trough at each end of the cabinet. When not in use these ash receptacles can be closed.

Blueprint, including full details for making this handsome smoking cabinet, can be secured by sending 25 cents to

Popular Science Monthly
250 Fourth Ave.
New York

The Home Workshop

The New Brushing Lacquers

(Continued from page 65)

some of the color. That causes what the painter calls "bleeding." That is, the color comes up through the finish and stains the hands or clothing. This condition does not occur with water stains, the coloring of which is insoluble in the lacquer thinners.

After the water stain had dried overnight, I had applied a coat of dilute orange shellac to the chairs and let it dry three hours then I had sanded the wood with the finest split sandpaper To give a still better surface, I applied a second coat of shellac and sanded it after it had dried.

"So you see, Dan, the chairs have had a coat of water stain and two coats of shellac as a preparation for the lacquer."

THE first thing to do now was to wash out the brush in some lacquer "thinner" made by the lacquer manufacturer. This would get the bristles clean and wet them with some of the same material used in the lacquer. It is not a safe practice, nor is it fair to the manufacturer, to use the thinner of one firm in the lacquer of another.

We turned one of the chairs upside down, as illustrated at the bottom of page 65, and then lacquered all the spindles, or chair rounds, below the seat starting on the inside and finishing each part complete before doing the next member. Dan soon found that about three strokes of his brush was about all he could use in working this lacquer, and that he had to start with a rather full brush. On the chair rounds the brushing is done from the leg joints towards the center of the round the legs can be brushed "around" or "up and down" whichever seems easiest

"This stuff does set up quick, doesn't it?" Dan commented "Isn't that a dandy gloss, though? You certainly can't brush this lacquer very much even if you do use a full brush can you?"

"No, Dan, you must certainly cannot brush it very much but if you are careful, the lacquer will flow out all right without much working Be careful how you hold your brush; it makes a big difference. There, that looks fine! Now take hold of the chair and stand it upright, so that you can finish the rest of the back legs before the lacquer gets set too much.

I then showed Dan how to "cut in" both the front and back faces of the slats, and how to use the side face of the brush to coat the top and bottom edges, thereby avoiding bristle marks in the face work Last of all I had him apply a generous coat to the rush-bottom seats of the chairs, making certain that the brush was well loaded, in order that the lacquer might flow down in between the braids, and thereby stiffen the seat after the lacquer had dried.

"How am I to set the chair down now without getting all stuck up, Mr. Waring?

Oh! I see, put my hands underneath the seat bottom and lift it down like this. Say! That certainly looks great, doesn't it?"

"Fine, Dan! Now fill up your cup to the three-quarters mark with lacquer and then add the last quarter of thinner. You see now why I had you use one of those ten-cent-store tin measuring cups, marked in quarters and thirds."

"But look, Mr. Waring! It all turns milky on top."

"All right, Dan. Just stir it for a minute and it will clear up fine. There, see! Now try that next chair, and after you have finished it, tell me which you like best—the lacquer straight from the can, or that which you thinned twenty five percent.

"This surely brushes a lot easier and smoother, doesn't it? It flows out smoother, too."

"In this case Dan, it does. Some brands I have tested lately have been thinned enough, others, I find, needed one part thinner to only two parts of lacquer, or a third reduction in order to brush properly. Whether you thin it or not is a matter of the brushing qualities of each brand. You will have to determine that as the occasion arises.

If you want to stop your work on the chairs for a minute or two I can take the time to show you now how to brush out lacquer on a dresser case as you see here (page 65). Use a well loaded brush to run the panel line first; then brush across the panel from left and right towards the center and starting at the top. Be sure the brush is as full of material as it can be without causing sags; then the lower edge of each stroke will stay wet and flow together with the top of the next stroke below. You will find that you cannot successfully do a panel with an up and down stroke.

"NEXT do the top and bottom cross rails, working from the leg joints in towards the center of the rail with right and left strokes. You will have to work rather fast and very carefully in order to get a smooth job. Last of all, take an up and down stroke on the legs, fading out the brush stroke in the center as you see here. That round foot in the front should be done with a circular stroke, starting at the top and bringing down a wet edge."

"That certainly is no enoch, is it? At that it has flowed out pretty good, and it certainly looks like a beautiful gloss varnish, doesn't it, Mr. Waring?"

You handled that like an old timer Dan it looks fine. Now finish those chairs, and by the time you get the last one done, you can start over again on the first for a second coat. Two coats are all right, but don't give three in less than twenty-four hours, for as the lacquer is made now, the third coat will soften the other two if they (Continued on page 89)

The Home Workshop

New Brushing Lacquers

are not well hardened. Sometimes large blisters will form if the undercoats get softened by the too early third coat.

"When you get through, put the thinned lacquer in this cleaned bottle, ready for the next job. Don't pour used goods back into the can, as dirt or lint may get in.

"If a skin forms over the lacquer left in the can add a little thinner and stir until dissolved. Wash out the brush very carefully with thinner, and wipe dry with a hard finished cloth free from lint, after which spread the cloth out to dry.

"BY THE way, Dan, don't ever use lacquer in a room where there is an open light or a fire, as in a range or gas stove."

One thing I'd like to ask," said Dan. "Would it be all right to put clear lacquer over an old varnish finish, provided the varnish was washed with soap and water, then with benzine or gasoline and finally sandpapered well?"

"It would save some work if it could be done, Dan, but exhaustive experiments have convinced me that lacquer of the clear or transparent type cannot be applied successfully over old varnishes or other finishes because the lacquer solvents invariably act as a varnish remover. Often the second stroke of clear lacquer will remove the old varnish entirely. The old varnish must be removed by scraping and sandpapering.

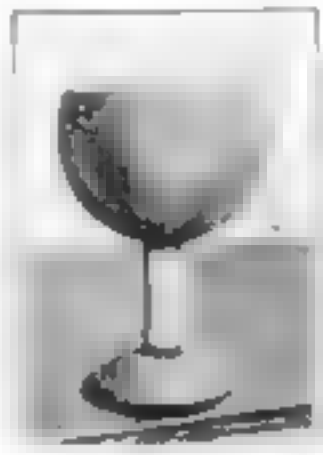
"The opaque lacquers, that is, those that give a solidly colored surface similar to enamels, can be applied directly over old finishes with more or less success, but if you will come around tomorrow I shall not only show you how to rub those chairs, but will also go into the use of lacquer enamels on furniture and on floors. How would you like that?"

"That would be fine," returned Dan, "for Mother has a kitchen floor I must refinish for her."

No home worker who expects to make use of the remarkable new brushing lacquers can afford to miss the next article by Mr. Waring, on opaque lacquers, which is scheduled for the September issue.

A Cocoanut Shell Bowl

TO MAKE this bowl, one end of a cocoanut was sawed off, the meat chopped out piecemeal, and ¼-in. holes bored in the center of both parts. A ¾-in. cylinder of wood was turned down at each end and a section from a broken cane slipped over the stem before the parts were glued together. Joints are decorated with black enamel.—OWEN LOVEJOT.

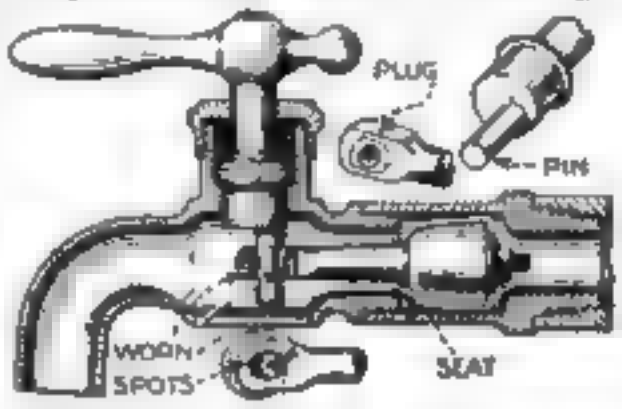


Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Shipshape Home

Repairing Worn Faucets

FAUCETS of the Fuller type, after long use, are apt to wear to such an extent that the plunger will not open far enough to allow the water to flow through



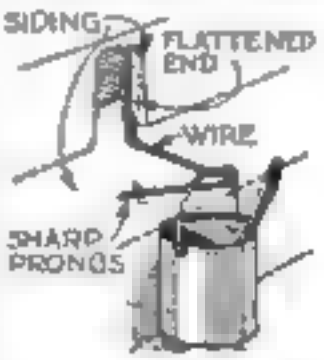
This type of quick-acting faucet, when badly worn, can be salvaged with little work

in sufficient volume. That is because the eccentric drive pin and the hole through the plunger in which this pin works become worn, as shown above.

A repair can be made easily. Clean the hole with a round file, make a brass plug, and solder it in the hole. If the pin also is much worn, saw it off, drill a hole in its place and solder in a new brass pin. Use the same drill to make a hole for the new pin in the previously plugged plunger. —WILLIAM SEIFERT

Hook for Paint Bucket

IN HOUSE painting I make use of a wire hook bent as shown to hold the paint bucket. The flat end is pushed up under the siding an inch or more, and the weight of the can of paint is sufficient to cause the pointed end to press down against the house and hold securely. I find it much more convenient than hanging the bucket on the ladder, as one does not have to reach over or under a ladder rung in order to dip the brush in the paint. —JOHN R. DODGE.



One end is slipped beneath the house boards

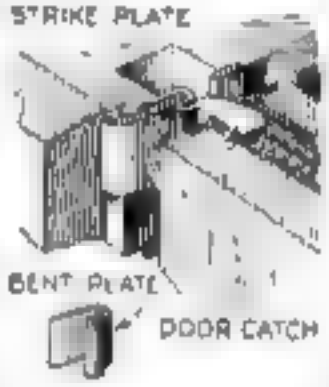
Insulating with Asbestos

THE ASBESTOS having fallen off one side of our furnace, I found that our plumber would charge eight dollars to replace it, so I undertook the work myself. For two dollars I bought 100 lb. of asbestos cement in the dry form. I strapped a piece of chicken wire as close to the side of the furnace as possible and then, after mixing the cement to a thick paste with water, I started to apply it at the bottom and worked up. The chicken wire held the cement and allowed a coating 1½ in. thick to be built up. I smoothed the surface with a long knife.

As there was some cement left over, I applied it to our hot water tank, starting at the top and working down. The cement was applied about 1 in. thick without any wire reinforcement. Although I covered only the upper half of the boiler I found that it holds the heat a great deal better and that the gas flame need be only one half its former height. The saving in gas paid for both jobs in the course of a few months. —GEORGE C. GRANT

Making Doors Catch

WHEN one of our doors kept constantly coming open, I hit upon the idea illustrated for making the lock catch. A piece of galvanized iron was bent as shown and sharpened along one edge so that it could be driven into the wood back of the metal strike plate on the door jamb. It was pressed into place with the flat side of a screw driver, which was tapped lightly with a hammer. The lip or turned-up portion extends outside of the plate and can be forced out or in, as necessary, to allow the spring catch on the door to hold. On one door this repair has served satisfactorily for more than ten years.—PIERSON W. BANNING.

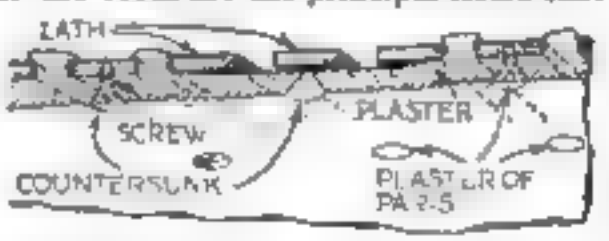


How the extra plate is bent and used in jamb

A Remedy for Ceilings

ON MANY occasions I have used with complete success the following method of holding up cracked plaster ceilings.

A few boards from 2 to 4 ft. long and several others 1 in. shorter than the height of the room are the principal items that



The plaster is fastened with countersunk screws, then holes and cracks are patched

are needed. The short boards are placed against the ceiling and the long boards are used to prop the cracked plaster back in place. This must be done carefully, and it is sometimes (Continued on page 91.

The Shipshape Home

(Continued from page 90)

necessary to use a putty knife to clean the cracks so that the plaster will go back in place smoothly.

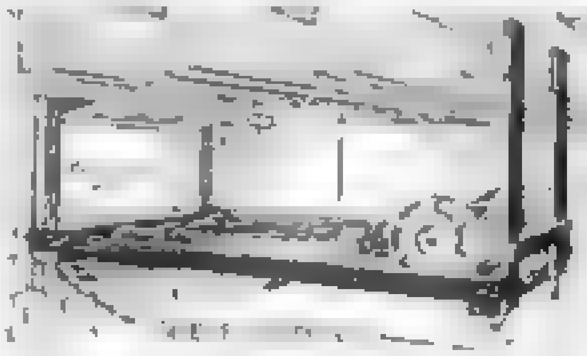
Make a number of countersunk holes and put a screw through each into the lath behind, making the screw head so that it will be well covered when the hole is filled.

Use a patching plaster or plaster of paris to fill the holes and cracks. Do not remove the props until the plaster has set.

A ceiling I fixed in this way fifteen years ago is still in as good condition as when first repaired.—VAUGHAN JONES.

Shelf for Lawn Mower

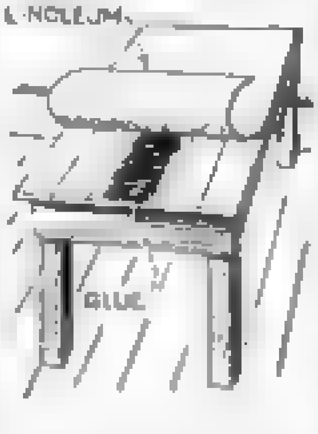
TO CARRY the lawn mower up from the cellar to the yard is heavy work and often the worst part of mowing the lawn. This task can be avoided by arranging a shelf on a line with one of the basement window sills as shown, if a window is available for this purpose. The lawn mower and other garden tools then can be placed easily on the shelf directly from the yard.—W. T. MARKOWSKI.



The mower does not have to be carried down the cellar steps but is placed directly on the shelf after pushing it through window

Top for Kitchen Table

TO IMPROVE a kitchen table the top of which had become warped and cracked, I dried the wood thoroughly, leveled it with a plane and sandpaper and then attached a piece of good quality linoleum with glue along the center only. This top remains flat, and is both durable and sanitary.—HAROLD JACKSON.



Only the center of the linoleum top is glued

How to Start Small Screws

IN TINKERING with a watch, camera, or other article containing very small screws, the householder who does not have a magnet handy often finds his ingenuity and patience sorely tried before he gets everything back in place. The flattened end of a wooden toothpick, if forced into the slot in the head of a tiny screw, will serve to start the screw. Then it may be tightened with a small screw driver.—JOSEPH C. COYLE.

Better Shop Methods

Old Bill Says—

Old Bill, machine shop foreman

MODERN methods demand modern equipment; the modern machinist must keep posted on the latest developments in the trade.

Talking about what you have done won't get you far in this or any other shop; let's see what you can do now.

A hand reamer is never intended to be run with power or to take a heavy cut because it cuts only on the side.

A chucking reamer cuts both on the end and side and may remove from 1 64 to 1 32 in. of metal, according to its size and the accuracy required.

When reaming a number of pieces always test the first hole to make sure that the reamer is not cutting oversize.

If the hole should be undersize with a power reamer, it can be sized accurately with a hand reamer.

Oil on a reamer often has a tendency to make it cut undersize.

A good mechanic will never abuse the costly tools and machinery provided for his use.

Always follow instructions on blueprints; do not depart from specifications without special instructions.

A little caution when starting an important piece of work is better than much haste—and being sorry at the finish.

Never try to hurry a tapping job; it's much better to take plenty of time than it is to break the tap. But this is not a suggestion to loaf on the job.

It's a Simple Matter to Set a Boring Tool

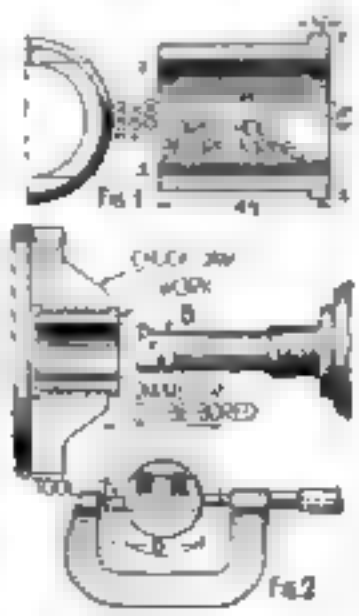
"WHAT are you trying to do to those bushings, Harry?" asked the Old Timer as he stopped a moment at a turret lathe, where a young workman was trying his best to bore out a number of bushings to size. There were twelve cast iron bushings, shown in Fig. 1 at A, with a 2¾ in. cored hole through the center. They were to be bored and reamed to 3.000 in. with a tolerance of +.001 and −.000 in. This called for careful machining to keep the work within the required limits.

"We haven't got a 3-in. reamer in the place, John," replied Harry, "and I've got to bore these bushings to size. I'm using two boring bars, one for roughing and the other for finishing, but I can't seem to get the finisher set to cut the right size."

"Look here, Harry," said John. "In the first place, you ought to use three boring bars instead of two—bore the hole with the first to about two and nine hundred fifty thousandths, with the second to about two and nine hundred eighty-five thousandths, and use the third for a finisher to bring your size. If you do this you won't have much trouble. Look at this sketch (Fig. 2); here's your boring bar B and your work. In setting your boring tools just take your micrometer and measure right across the bar and tool as at D."

"Yes, but how do I get the size to set the micrometer?"

"Why that's easy enough," answered John. "Just take the diameter you want to bore and the diameter of the boring bar—add them together and divide by two. For example, your finish boring tool is to cut three inches, your bar is two inches. Then three plus two divided by two equals two and a half. Set your mike to this size and adjust the tool to the measurement. For your roughing tools do the same thing. You may have to make a small adjustment on account of the spring of the bar, but it won't be much. It's a good thing to remember this for all kinds of boring jobs." And the Old Timer passed on down the shop.



The work (Fig. 1), and setting the tool (Fig. 2)

AS a bricklayer in a steel mill, I had trouble with my hammer handle falling off because of the heat. In place of wedges, which did not hold, I drilled a hole into the end of the handle and used a bolt and washer to retain the head. A slot was cut in the handle beneath the head to allow the nut to be inserted.—JAMES C. BROWN.

Burning-In Motor Bearings on an Engine Lathe

REGULAR equipment for burning-in the bearings of a gas motor is expensive, but the job may be done on an engine lathe if one is available.

The universal joint is fitted to a bar of square stock and the bar is placed in the lathe chuck and trued up. Square stock

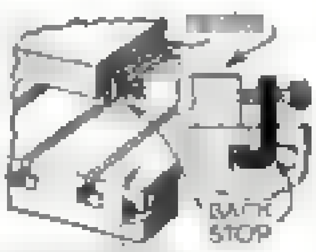
The motor is mounted on the lathe and turned by means of a bar held in the lathe chuck

is better than round stock, for it does away with any tendency for the bar to turn in the chuck.

After the tailstock of the lathe is removed, the motor is placed on the lathe and bolted down. The transmission cover was removed when the accompanying photograph was taken in order to show the attachment of the universal joint, but it is necessary to have the cover on while the lathe is running to prevent the oil from being thrown out.—HARVEY MEAD

Simply Made Stops for Clamping Shallow Planer Work

SOMETIMES planer work is of such a shape that the regular stop holes cannot be used, and to meet this contingency one shop made a number of clamps like that illustrated. They are made of bar iron, and can be slipped into the tee slot at any point. The pressure of the screw against the work holds each firmly in position.—R. H. KASPER.



Putting New Life into Worn Typewriter Rollers

TO RESTORE a worn typewriter or adding machine roller, I mount it on a lathe and file off the rough marks with a 12-in. fine cut file. The roller revolves at a fairly fast speed and little pressure is used.

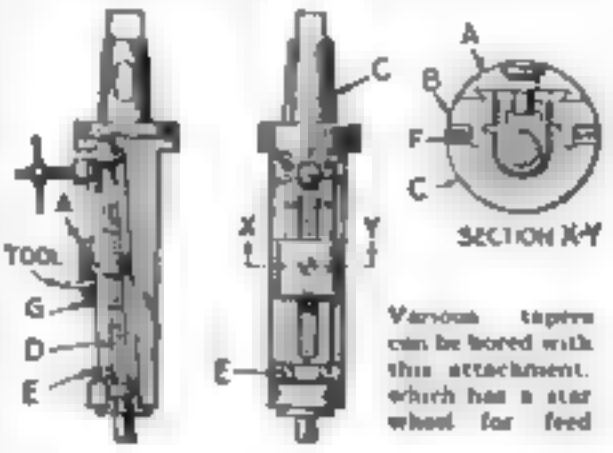
Then a piece of 00 sandpaper or finer is applied to smooth off the file marks. An additional polish may be given by holding the palm of the hand on the roller for a short time. This method removes the outer dead surface of the rubber and makes the roller almost like new again.—T. W. NUSHEIMER.

Better Shop Methods

An Adjustable Taper Boring Tool for the Drill Press

WHILE first made for boring taper holes in crossheads on a drill press, the tool shown in the drawing may be used for any taper boring on a drill press, milling machine, or horizontal boring machine. To be successful, it must be carefully made; the slides and joints must be tight and it should be used in a machine having no end play in the spindle.

The bar C is of machine steel, tapered to fit the spindle, and has a slot for a retaining key as shown. It is planed out (on a taper) to give room for the feed



Various tapers can be bored with this attachment, which has a star wheel for feed

screw D and nut, and has grooves to fit the tongues on slide B.

The feed screw is journaled in the bar and has a pair of miter gears and a star wheel at the upper end for a power feed. The tool holder A is a good fit on the slide, and is provided with a hole and set screw G for a tool. Another screw goes through to engage loosely the feed nut.

Various tapers, or even straight holes, can be bored with this tool, for the slide B is pivoted near the top and can be adjusted by the screws E, one of which is a set screw and the other a cap screw. After an adjustment is made, additional security is provided by several screws F bearing on the slide tongues.

Screw Key for Light Drives

A SIMPLE, cheap and effective method of keying a shaft and pulley together is shown in the accompanying illustration. While this way of fastening is applicable only where the end of the shaft is flush with one face of the pulley, and should not be tried where a hard pull is required, it is highly effective in those still numerous cases where it may be applied.

Its chief advantages are that it does away with the necessity of cutting two keyways, an operation for which many of the smaller shops are not well prepared, at least when it comes to forming the internal keyway, and that it positively locates and holds the pulley in position on the shaft longitudinally, besides acting as the driving link. All that it is necessary to do can be done in the drill press and with a tap.

This keying method has many applications

This method possesses the added advantage of doing away with all trouble in disassembling the parts. While the pulley and shaft should be flush in drilling and tapping the keyhole, it is still possible to adjust the pulley on the shaft by a predetermined small amount, that is, the width of a thread. The key-screw, being automatically under a tension while the shaft is running, is less likely to work loose than a radial set screw.

This fastening method also can be applied to many non-moving parts, where the circumferential and longitudinal position must be held.—HENRY SIMON

Sheet Metal Screw Driver Guide

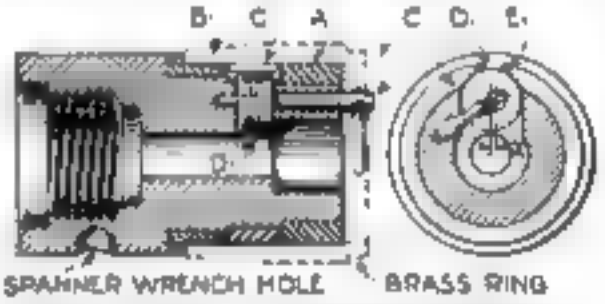
A MECHANIC was tightening up a screw in a turret lathe tool holder when suddenly the screw driver slipped and he suffered a badly cut hand. Not wishing to repeat the experience he devised a simple sheet metal guard bent to fit over the screw.

Screw driver guard on a tool holder

The metal piece was sweated in place and a hole drilled for the entrance of the screw driver. In the illustration the guard is shown in use on a drill holder, where the thin wall of the holder makes it preferable to use a slotted screw rather than one requiring a wrench.

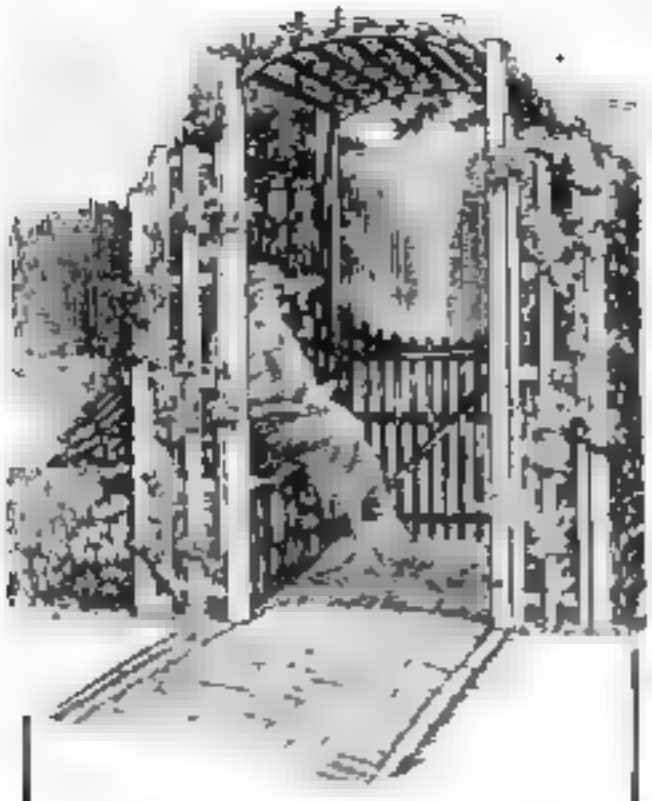
Special Chuck for Holding Light Brass Rings

A MANUFACTURING shop with a quantity of thin brass rings of the shape shown in broken lines in the illustration had considerable difficulty in machining them on the outside when holding them in the usual chucks or on an arbor.



How the chuck is made. The work, indicated by dotted lines, is held by the expansion of ring C, which is operated by cam D

The special expansion chuck illustrated was then designed and made. The ring C is expanded by the eccentric D. This ring is made of tool steel and given a spring temper; the ends are beveled as indicated at E. The rings A and B are turned to a sliding fit in the brass rings to be machined. A small handle F serves to operate the eccentric.—FRANK N. COAKLEY.



You, too, can have a

Beautiful Garden

NOTHING will add more to the attractiveness of a well-kept garden than an arbor, especially if it has comfortable seats

This arbor, with its arched top, its quaint gate and its two roomy seats, is a perpetual invitation for one to linger and rest. Although of distinctive design and substantial construction the arbor may be built easily by any one who can handle a hammer and saw

A further advantage of this arbor is its adaptability to various uses and locations. Besides being used as a garden gate, it can be used to add architectural distinction to an otherwise plain front entrance to the house or to decorate the side entrance to a garage.

If the gate is not desired it may be omitted, although it adds materially to the charm of the arbor. If there is not sufficient depth available for the seats, or if the seats are not needed, they also may be omitted so that the arbor will consist only of an arched latticework over the gate.

No skill with tools is required. A very simple blueprint has been prepared that will help you build this charming addition to your garden. The Blueprint includes a bill of material needed. It will be sent to any address on receipt of 25c

POPULAR SCIENCE MONTHLY
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New York

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250 Fourth Avenue, New York

I am enclosing 25c for which please send me Blueprint No. 9 of the Arbor, Gate and Swing.

Name

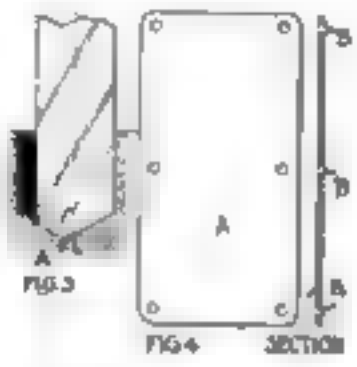
Street

City and State

Can You Grind a Drill?

sent them back to be burred because the holes looked like this—" and he made a sketch as at B, Fig. 4. "We have had to use a countersink to remove the burr. The assembling department doesn't mind a little burr, but these were too rank. Is there any way we can get rid of the burr?"

"Why don't you use a flat drill like this?" asked Grimes, making a sketch as in Fig. 5. "Take a piece of drill rod and form the end as at A. This will go through the metal without tearing it as a twist drill does and I do not think any burring will be necessary. Incidentally, this work should not be drilled anyway—it is too slow. All six holes should be done at one time on a punch press. I will suggest making punches and dies for the job next time it comes through."

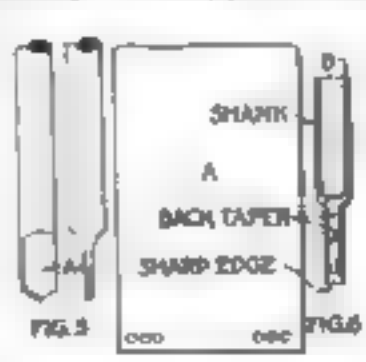


The result of grinding a drill off center (Fig. 3) and drilling job that gave trouble (Fig. 4)

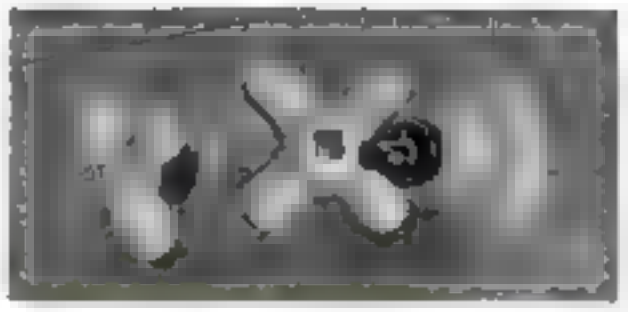
"We had a drilling job a year or two ago that was pretty mean," said Harvey. "The accounting department sent down twenty thousand sheets of paper (Fig. 6) and wanted us to drill six holes—three-sixteenth inch—along the edges so they could file them in loose-leaf binders. We made a jig plate to locate the holes and then clamped about one hundred sheets at a time together and drilled them with a twist drill. The first and last sheets in the pile were not very good but the ones in the center were not bad. How could we have done that job easier?"

"The best kind of drill for paper is of tube form (as shown at B), the right outside diameter, relieved inside, and tapered to a keen edge. It should be tempered to dark brown and should be run about one hundred feet per minute. The inside is back tapered to allow the paper cuttings to pass through freely. Frequent cleaning is, of course, necessary. This type of drill cuts freely and gives a very clean hole.

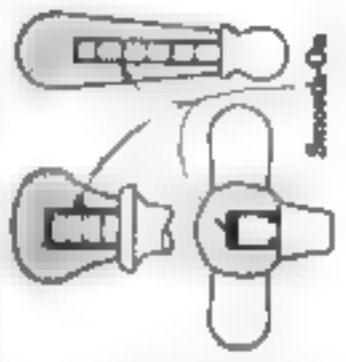
"A similar method is sometimes used for drilling glass or porcelain, but copper or brass tubing is employed faced off square on the end. Carborundum and light oil are fed under the end of the tube with a stick of wood. The glass should be well supported on felt or rubber and the drill should go through the support after passing through the glass, to avoid fracture. A three-cornered file lubricated with camphor and (Continued on page 103)



A flat drill (Fig. 5) and a hollow paper drill (Fig. 6)



Porcelain handles will *stay* tight if set with SMOOTH-ON No. 1



TO MAKE porcelain handles tight on bath tub and wash bowl faucets, and on sink and flush tank pulls, fill the hole in the handle with a soft putty of Smooth-On No. 1, and then force the handle onto its spindle. Once the Smooth-On hardens, it becomes solid metallic iron, which will keep the handle tight for all time. You yourself can make this repair equal to a professional job and at a cost of only a few cents.

Keep Smooth-On handy and you can save much money on such repairs as:—Stopping leaks in steam, water, gas, oil or stove pipes, mending cracks, breaks or leaks in furnaces and boilers, radiators, tanks, sinks, pots and pans, making loose handles tight on umbrellas, knives, hammers, brushes, drawers, etc., tightening loose screws, hooks, locks, door knobs, etc.

Use it also on your car for making burst water jackets and pumps good as new, stopping leaks in radiator, hose connections, gas tank, and gas, oil and exhaust lines, making a fume-proof joint between exhaust pipe and tonneau heater, tightening loose headlight posts, keeping grease cups, hub caps and nuts from loosening, etc.

Write for FREE BOOK

Get Smooth-On No. 1 in 7-oz. or 1 or 5-lb. can at your hardware store, or if you want us to send a 7-oz. sample can, enclose 15 cts. in stamps.

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POPULAR SCIENCE MONTHLY believes that every man has the power of success within himself. No matter what others may tell you, no matter what obstacles you have to overcome, if you want to succeed, then you can succeed. Read all the advertisements in this section and see how easily you can be what you want to be.

$25 in
CASH PRIZES

For the best letter of 170 words or less answering the question—

"What advertisement in the 'Money-Making Opportunities' Section interests you most—and why?"

we will pay on September 10th the following—

CASH PRIZES

First Prize	$10.00
Second Prize	5.00
Third Prize	3.00
Seven Prizes of $1.00 Each	7.00

First read every advertisement in the Money-Making Opportunities Section on pages 104 to 127. Pick out the one that interests you most and then write a letter—*not exceeding 170 words*—telling us why you find the advertisement you have selected the most interesting.

Entries for the contest will close on August 1st. The prize winners and their letters will be published in the October issue of POPULAR SCIENCE MONTHLY.

Address your letter to

Contest Editor

MONEY-MAKING OPPORTUNITIES

POPULAR SCIENCE MONTHLY

250 Fourth Ave., New York

Electrical Experts are in Big Demand!

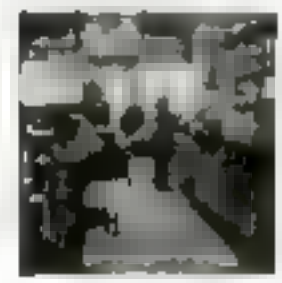
L. L. COOKE
Chief Engineer

It's a shame for you to earn $15 or $20 or $30 a week, when in the same six days thousands of men as Electrical Experts are making $70 to $200—and do it easier—not work half so hard. Why then remain in the small-pay game, in a line of work that offers no chance, no big promotion, no big income? Fit yourself for a real job in the great electrical industry. I'll show you how

Be an Electrical Expert

Learn to Earn $3,500 to $10,000 a Year

Today even the ordinary Electrician—the "screw driver" kind—is making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the Electrical Expert—who is picked out to "boss" the ordinary Electricians—to boss the big jobs—the jobs that pay $3,500 to $10,000 a year. Get in line for one of these "Big Jobs." Start by [redacted] for my easily learned, quickly grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.



$700 in 24 Days

"Thanks to your interesting course I made over $700 in 24 days in Radio. Of course this is a little above the average but I run from $10 to $15 clear profit every day so you can see what your training has done for me." PIERCE O. McNAIR, 1 W. 10th St., Atlanta, Ga.

I Will Train You at Home for a Big Pay Job

5 Big Fine Outfits to work with *No Extra Charge*

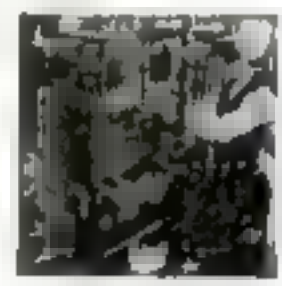
With me, you do practical work — at home. You start right in after your first few lessons to work at your profession in the regular way and make extra money in your spare time. For this you need tools, and I give them to you — 5 big complete working outfits, with tools, measuring instruments, and a real electric motor — 5 outfits in all.

Age or Lack of Experience No Drawback

You don't have to be a College Man; you don't have to be a High School Graduate. As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training you need, and I will give you that training. My Course in Electricity is simple, thorough and complete and offers every man, regardless of age, education or previous experience, the chance to become, in a short time, an "Electrical Expert," able to make from $70 to $200 a week.

Your Satisfaction Guaranteed

So sure am I that you can learn Electricity—so sure am I that after studying with me, you, too, can get into the "big money" [redacted] work, that I will guarantee under bond to return every single penny paid me in tuition, if, when you have finished my Course, you are not satisfied it is the best investment you ever made. And back of me in my guarantee, stands the Chicago Engineering Works, Inc., a two million dollar institution, thus assuring to every student enrolled, not only a wonderful training in Electricity, but an unsurpassed Student Service as well.



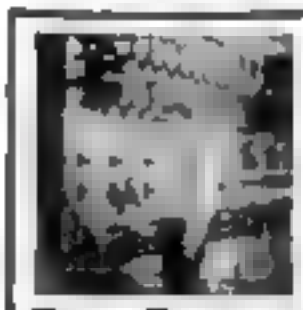
$20 a Day —for Schreck

"Use my name as a reference and depend on me as booster. The biggest thing I ever did was answer your advertisement. I am averaging better than $600 a month from my own business now. I used to make $15 a week." A. SCHRECK, Phoenix, Arizona

Free Book on Electricity

I want to send you my Electrical Book and Proof Lessons, both Free. These cost you nothing and you'll enjoy them. Make the start today for a bright future in Electricity. Send in Coupon—*Now!*

L. L. COOKE,
Chief Engineer
Chicago Engineering Works
2150 Lawrence Ave.
Dept. 3-C **Chicago**



Pay Raised 150%

"I was a dumbbell in electricity until I got in touch with you Mr. Cooke. Now I have charge of a big plant including 400 motors and direct a force of 30 men — electricians, helpers, etc. My salary has gone up more than 150%." GEO. ILLINGWORTH, 48 Calumet Road, Holyoke, Mass.

GET MY FREE BOOK

Get Started Now! Mail Coupon

L. L. COOKE, Dept. 3-C, 2150 Lawrence Ave., Chicago

The Man Who Makes "Big-Pay" Men

Send me at once without obligation your big Illustrated book and complete details of your Home Study Course in Electricity, including your outfit and employment service offers.

Name _____

Address _____

Occupation _____

The "Cooke" Trained Man is the "Big Pay" Man

Opportunities for Readers in Quick Action Advertising

Rate 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the Oct., 1926 issue should be received by Aug. 5th.

Adding Machines

HELP! Small manufacturer now adding machines. Article total sets, multiplies, divides automatically. Write for sample $450.00 machine. Price only $75.00. Special discount. Guaranteed by largest outfit in the world. Write today for catalog and free trial offer. Comptometer Co., 1702 North Halsted, Chicago, Michigan.

Advertising Services

ADVERTISE in 4 fast-expanding daily papers, 4 weeks $1.00. Digest of 1000 leading mail order papers 50c. Advertising Exchange, 4 Park Row, New York.

20 Words or less in all weekly newspapers, $120.00. Advertising, 4 Park Row, New York.

ADVERTISING posters. All publications. Lithographs, Envelope Enclosure Cards. Catalog free. Agents Wanted. Poster Advertising Co., Inc., New York.

Authors and Manuscripts

PHOTOPLAY story ideas wanted. $2,500 paid. Experience unnecessary. Outline Free. Write Producers Service, Dept. 10, Los Angeles.

Stories, poems, plays, etc., are wanted for publication. Submit manuscripts or write Literary Bureau, 54 Times Square Building, New York.

I WANT song poems. Cooper Nelson, 2434 No. Racine, Chicago.

$50 paid for one idea. Photoplay plots considered or may form Writer's Club for mutual help. Details free. Universal Scenario Co., 6 Beverly Bldg., Santa Monica & Western Ave., Hollywood, Calif.

Song Poems Wanted. Have Hit Published. Free Booklet. Send Poems. Chas. D. Isbell, 1674 Broadway, New York.

Automobiles and Accessories

FREE! Books for Ford Model T owners with instructions, data, and cuts for Conversions, Trucks, Roadsters and Pickups. Three books Free. Write Daniel Chamberlain, Dept. 10, Indianapolis.

Please 35 cars for a Firelight. Tell all motorists to keep the driving hands thereby preventing the Nimrods de Mass.

AUTO LAMPS and spring oil for most closing 30% discount. Dealers write. Catalog Free. Dept. 10, Auto Lamp Co., Detroit, Mich.

Ford owners! Increase speed and power of car with Ford Accessories. Send for catalog. Ford Accessories Sales Manufacturing Co., Akron, Ohio.

Aviation

THE American School of Aeronautics announces a new correspondence course in Mechanical Aviation. A thorough training at practical aeronautics. American School of Aeronautics, Dept. 6-10, 1601 Michigan Ave., Chicago, Illinois.

BUILD your own model aeroplane. Scientific principles for 10c. Aero Mfrs., 2000 Hartford Ave., Detroit, Mich.

WANTED: Men Men interested in earning extra pay, school or job. Write for booklet and full details. Aeronautical Dept., Box 90, Dayton, O.

AIRMAN Through Home Study in Spare Time. Prepared by Leonard Hicks. Circular 10c. Send for it Now. Always Helped. Hap Hicks, Capt.

AVIATION Instruction. Ship training by aspiring pilots and boys and many other uses. Large size 10 cents Sheffield, 25 cents Amalfi, 10 cents Dandelion, 10 cents postpaid. Johnson Airplane and Supply Co., Dayton, Ohio.

FREE BOOKLET for Air Propulsion Information. Blue prints, of vital things one must know to build an airplane that will fly. Crawford Airplane Manufactory, Long Beach, Calif.

LEARN to fly. Write for booklet. Robertson Aircraft Corp., Anglum, Mo.

Boats and Launches

SPEEDY boat. Ford propelled craft. Blueprint and directions sixty cents. Marine motor booklet free to Ford boat owners. C. C. Hubbell, 40 East Ave., Norwalk, Conn.

$10 to $100 per week. Learn designing speedy V-Bottom, Hydroplane, Runabouts, sport cruisers, etc. 35 models known. Write for particulars. Send 10c for catalog. Reports Boat Co., Inc., Main Street, Saginaw, West Side, Mich.

WANTED: Representative in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

Blue Prints

TO the man who has a Home Workshop and likes to work with tools Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blueprints available: No. 1 Sewing Table; No. 4 Kitchen Cabinet; No. 13 Fly Wagon; No. 15, Workshop Bench; No. 17 Cedar and Mahogany Chest; No. 41 Five Tube Radio Set; No. 42 Radio Receiver with three stages of amplification; No. 43, Four Tube Radio Receiver; 44 and 45 Model Pirate Ship; 46 and 47 Spanish Galleon; 48, Model Sailing Yacht. Send 10c for each blue print that you wish to Popular Science Monthly, 250 Fourth Avenue, New York, N. Y.

Branch Offices

ATTORNEYS and others Wishing Mail Addresses in Washington, D. C. Write Service, 517 Munsey Bldg.

Business Opportunities

[illegible] Order Business. Just [illegible] and Invest Now in It.

[illegible] Make $5 to $10 Daily. Sell Advertising Specialties. Write for Free Sample Case Offer. Quick Seller Mfg. Co., 1922 Jackson Blvd., Chicago.

[illegible] Agents Wanted. Sell Advertising Specialties. Big Profits. Experience Unnecessary. Write Today. Ideal Manufacturing Co., 1922 Jackson Blvd., Chicago.

[illegible] A New Profession. Become Certified Public Accountant. Thorough training by mail. Prepare for C. P. A. examinations. Write for free booklet. Accountancy Extension, Dept. 1, Chicago.

[illegible] Mail Order Business. Start in your spare time. Unusual opportunity. Booklet free. National Salesmen's Association, Publishers Building, New York.

[illegible] Wanted. Men to Sell Guaranteed Hosiery direct to wearer. Big repeat business. Permanent. Experience unnecessary. Write for sample outfit. Quick sales. Credit. Advance pay. Spare time. Macochee Knitting Mills, Dept. 1, Cincinnati, Ohio.

[illegible] Wanted. Sell Direct to wearer. Guaranteed Hosiery

Complete List of PRIZE WINNERS in the June Contest

FIRST PRIZE $50
Lieut. John H. Schurmer,
New York, N. Y
(National Salesmen's Training Association)

SECOND PRIZE $25
Frederick J. Pease, Waurwatosa, Wis.
(Lederer School of Drawing)

THIRD PRIZE $10
Rose Kathryn Moore,
Huntington Park, Calif.
(Prof Henry Dickson

PRIZE WINNERS who receive $1 00 each for their letters:

Howard Lord, Clearfield, Pa.
(International Correspondence Schools)

Edward Kent Whitcomb, Lancaster N. H.
(Coyne Electrical School

J. R. Glenn, Harrisburg, Penn.
(Mayer Both Company)

Mrs. W. F. Sandmann, Indianapolis, Ind.
(Victor J. Evans & Co.)

P. R. Kern, Belleville, Illinois
(Northwestern School of Taxidermy)

Thomas Balliotta, New York, N. Y
(Economy Educator Service Co.)

George D. Reynolds, Altoona, Pa.
(La Salle Extension University)

J. E. Parker, Parker, N. C.
(Theo. Audel & Co.

Mrs. A. E. Graham, Moline Ill.
(Furniture Studios)

Clement Capuano, Brooklyn, N. Y.
(American School of Aviation

Phillip Boyle, Wilkes Barre Pa.
(Washington School of Cartooning)

Rubin Heisner, New York, N. Y.
(International Correspondence Schools)

Charles L. Kimball, Hallendale, Fla.
(Victor J. Evans & Co.)

Charles Nelson, Academy S. D.
McGraw Hill Book Co.)
(International Correspondence Schools)

William Weaver, Santa Anna, Texas
(American School of Aviation)

For Inventors

INVENTORS Universal Educator contains 500 mechanical movements; 50 perpetual motions. Tells how to obtain and sell patents. Suggests new ideas. Explains how to select your attorney and avoid patent sharks. Price, revised edition, $1.50 post paid. Albert P. Thurston, 661 Shoreham Bldg. Washington, D. C.

UNPATENTED ideas can be sold. I tell you how and help you make the sale. Free particulars. (Copyrighted) Write W. T. Greene, 805 Jenifer Building, Washington, D. C.

INVENTIONS Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co. 153 Enright, St. Louis, Mo.

WANTED—Improvements on every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

SELL your patented or unpatented inventions. Write for my three plans. Free. Hartley, 44 Central St. Bangor, Maine.

INVENTORS Get this pamphlet "What to Invent." No theory or guess work but things actually asked for by manufacturers. Sent prepaid for only $1.00. Inventors Syndicate, 21 Patterson Bldg. St. Louis, Mo.

INVENTORS Preliminary Investigations only to determine if your inventions are patentable. Neither preparing nor prosecuting applications for patents. I am in a position to give you honest opinions. Communications permit. R. Ewalt Patterson, Barrister Bldg. Washington, D. C.

YOUR ideas developed. Confidential. Drawings made. Experimental tests substituted. Models built complete. Low cost. The Practical Mechanic, South Haven, Mich.

Continued on page 100

For Men and Women

DETECTIVES. Work home or travel. Experience unnecessary. Write, George Wagner, former Government Detective, 2640 Broadway, N. Y.

MR. ADVERTISER: Ask today for a copy of the Quick Action Advertising Rate Folder. It contains some really important facts which will prove interesting and valuable to you. It also tells How You Can Use Popular Science Monthly Profitably. You'd like to know wouldn't you? Address your inquiry to Manager Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

For Sale

FOR Sale. Small Automobile School located in Cicero. Average $7,000.00 a year gross. One man can handle. Write F. J. Hron, [illegible] Cicero, Ill.

FOR SALE: Factory Manufacturing Business Wholesale and Retail. For quick sale $2,500.00. Owner needs money. Address F. J. Hron, 5600 West 25th St., Cicero, Ill.

For the Home

HOT WATER IN TAP [illegible]. Make your own automatic. Write John Kirkeby, [illegible] Chicago, Calif.

[illegible] Write for full particulars. [illegible]

[illegible] Popular Science Monthly [illegible] New York, N. Y.

Help Wanted

[illegible] French plate [illegible] Plans free. [illegible]

[illegible]

[illegible] New York.

[illegible]

[illegible]

WANTED—Representative [illegible] United States. Popular Science Monthly, 250 Fourth Ave., New York.

Help Wanted Instruction

DETECTIVES Earn Big Money. Excellent opportunity. [illegible] unnecessary. Write, George Wagner, former Government Detective, 2640 Broadway, N. Y.

[illegible] $250 [illegible] Experience unnecessary. [illegible]

[illegible] Become Railway Mail Clerks. [illegible] Sample coaching free. Franklin Institute, Dept. [illegible] Rochester, N. Y.

Incorporations

DELAWARE Incorporations. [illegible] Free Small forms. Chas. G. Guyer, 901 Orange St., Wilmington, Delaware.

Insects Wanted

WHY not spend Spring, Summer, and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth $1 to $7 each. [illegible] instructions, pictures, price list. Send 10 cents (not stamps) for my illustrated Prospectus before sending butterflies. Mr. Sinclair, Dealer in Insects, Dept. [illegible] Box 1424, San Diego, Calif.

Laboratory and Chemical Services

MELT Metals and Alloys with SPEEDEE-BILT Electric Furnaces, $7.00. The Booth Electric Furnace Co., Room [illegible] Chicago, Ill.

FORMULAS. The Best Chemical Science Can devise. Guaranteed Reliable Processes in all lines. Stamp brings Big Bunch of Valuable literature. Interesting lists. Don't buy till you receive this. Chemical Analysis. Charges reasonable. Dr. Liscomb Miller, Chemist, Tampa, Florida.

EXPERIMENTERS—Complete Chemical Apparatus and Radio Catalog. 1000 illustrations. Price 25c refunded on $5.00 order. Laboratory Materials Co., 641 East 71st St., Chicago.

CHEMICALS and reagents; quickest delivery guaranteed. Prices reasonable. List free. Dettig & Haupt[illegible], 1690 Park Ave., New York.

FORMULA by Richards means the best. Your chemical problem solved and working process furnished $5.00. Write me. W. Stedman Richards, Industrial Chemist, Box 2402, Boston, Mass.

Information

CORRECT complete information any event [illegible] Encyclopedia, [illegible]

ACCURATE specific information on any subject $5. National Information Bureau, [illegible] Grand Rapids, Michigan. Prompt service, satisfaction guaranteed.

Languages

WORLD-ROMIC System. Masterkey, [illegible] Languages. Primers $1.95. Chinese, French, Spanish. Languages, [illegible] New York.

Machine Tools

CONCRETE Building Block Machines and Molds. Catalogue free. Concrete Manufacturing Co., [illegible] St. Louis, Mo.

MR. ADVERTISER: Ask today for a copy of the Quick Action Advertising Rate Folder. It contains some really important facts which will prove interesting and valuable to you. It also tells How You Can Use Popular Science Monthly Profitably. You'd like to know wouldn't you? Manager Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

Magic Tricks

BE a magician, give shows, earn money. [illegible] Magic [illegible] Tricks, Novelties. Catalogue free. [illegible]

Mailing Lists

NEW lists: Good buyers, housewives, tradesmen, dentists. $5 a 1000. J. Dunlap, 1142 Rose Street, Philadelphia.

Mail Order Business

[illegible]

Manufacturing

[illegible]

[illegible] castings and [illegible] New York.

Models and Model Supplies

SPECIAL machine [illegible] and die makers [illegible] Ravenswood and [illegible] Chicago, Ill.

[illegible] Models Makers. Free. Patterns [illegible]

Motorcycles, Bicycles, Supplies

OVERSTOCKED Used Motorcycles. 1925 Indian [illegible] 1925 Harley [illegible] for free list. Morrow Brothers Co., 14 Berkeley St., Boston, Mass.

[illegible] bicycle motor attachment [illegible] our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galesburg, Kansas.

Motors, Engines, Machinery

[illegible] 3450 speed [illegible] $14.50 [illegible] Electric [illegible] Toledo, Ohio.

[illegible] Toledo, Ohio.

Musical

SAXOPHONISTS—Clarinetists—Cornetists—Trombonists, get "Free Pointers." Virtuoso Music School, [illegible] Buffalo, N. Y.

Novelties

IMPORTED French Novelties and Art. 6 Samples $.50. Cagnew Productions, 43 West Sherman, [illegible] Penna.

NOVELTIES, Magic, Books, Puzzles. Catalogue free. K. Mac, 706 Temple, Detroit.

Optical Goods

ARTIFICIAL eyes. Booklet free. Denver Optic, 500 Barclay, Denver, Colorado.

Office Devices

ADDRESSING machines, multigraph, duplicators, folders, check writers, sealers, dictating machines at about half new cost. Pruitt, 174 N. Market St., Chicago.

WANTED—Representative in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

Patent Attorneys

PATENTS. Time counts in applying for patents. Don't risk delay in protecting your ideas. Send sketch or model for instructions or write for FREE book, "How to Obtain a Patent" and "Record of Invention" form. No charge for information on how to proceed. Communications strictly confidential. Prompt, careful, efficient service. Clarence A. O'Brien, Registered Patent Attorney, Security Bank Building (directly across street from Patent Office), Washington, D. C. See page [illegible]

INVENTIONS [illegible] Patent Book [illegible] New York.

PATENTS. Before disclosing an invention the inventor should write for our blank form "Record of Invention." [illegible] Victor J. Evans & Co., 927 South, Washington.

PATENTS, trade marks, copyrights. Prompt personal reliable service. [illegible] Write for [illegible] Book. [illegible] Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 644 G Street, Washington, D. C.

[illegible] New York.

[illegible] Write W. T. Greene, [illegible] Building, Washington, D. C.

[illegible] Washington, D. C.

[illegible] Patent Office [illegible] Patent Attorney, [illegible] New York.

[illegible] Bldg., Washington, D. C. [illegible]

PATENTS [illegible] United States and Canada [illegible] Washington.

[illegible] Trade Marks Registered. [illegible] Washington, D. C. or [illegible] Park Row, New York.

[illegible] Patent Lawyer, Washington [illegible]

[illegible] registered in U. S. and Canada.

[illegible] Patents. Instructions [illegible]

PATENT Book Free. Charles W. Lovett, Patent Attorney, [illegible] Mass.

PATENT [illegible] A. M. Beamer, 517 Victor Bldg., Washington, D. C.

[illegible] Washington, D. C. Established 1869.

Patents Wanted

PATENTS wanted. We buy and sell practical patents. Big opportunity, undeveloped field. Describe briefly. M. [illegible] Box [illegible]

Photographs and Supplies

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, [illegible] Camera House, Boston, 17, Massachusetts.

LEARN [illegible] yourself at home as a photographic expert, make $[illegible] a week while learning. Professional camera [illegible] Write quick for full information. [illegible] Studios, Dept. 1742, 3601 Michigan Ave., Chicago.

Printing and Engraving

EMBOSS your Stationery with Hand Embosser. Circular Free. Midwest, Box 47, Springfield, Illinois.

BETTER Printing for Less Money. Write us about your printing needs and you will save money. [illegible] Printing Company, [illegible] South Dearborn Street, Chicago.

[illegible] Grade Printing, [illegible] Bond Letter Heads, [illegible] 10,000 $24.00 [illegible] envelopes, five thousand, $10.00. The Courier Company, Zanesville, Ohio.

[illegible] printing outfits, presses, type, ink, paper supplies. Write for Catalog. Press Company, [illegible] Meriden, Conn.

200 LETTERHEADS [illegible] 200 Business Envelopes, [illegible] Return Envelopes, $3.00. Falcon, 4671 Louisiana, Saint Louis.

MR. ADVERTISER: Ask today for a copy of the Quick Action Advertising Rate Folder. It contains some really important facts which will prove interesting and valuable to you. It also tells How You Can Use Popular Science Monthly Profitably. You'd like to know wouldn't you? Address your inquiry to Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

Salesmen and Agents Wanted

AGENTS—Clever invention! Inkspoon makes every pen a fountain pen. Fast office seller. Big profit. Demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Bldg., New York.

INSTANT Weld—Repairs large punctures without cement or heat. Lens a profit one day, $[illegible]. Write quick. Free sample. Territory going fast. Tourist a Pride Mfg. Co., Desk R, Minneapolis, Minnesota.

GET our free sample case—toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F, St. Louis, Missouri.

WASH Dishes the new way. Use the Torrent Automatic Washer. You will be delighted. Special offer to one in each locality. Storm Royalty Co., 3860 Enright Ave., St. Louis, Mo.

AGENTS—$60–$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A N. Clark, Chicago.

TAKE orders for coffee, sugar, flour, teas, canned goods, staple groceries, also paints, radio sets, tires, gas [illegible]. No capital or bond required. We deliver and collect. Permanent business. Big pay. Write at once. [illegible] Co., Dept. 83, Chicago.

BANKRUPT and Rummage Sales. Make $50.00 daily. We start you, furnishing everything. Distributors, Dept. 34, 609 Division, Chicago.

$[illegible] DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

SELLS for $0.75. Prints ad on wrapping paper, envelopes, etc. $1.00 commission. Send [illegible] for sample. Work. Automatic Ad Stamper, Joplin, Mo.

FREE booklet describes 6[illegible] plans for making $20.00 to $[illegible], home [illegible] or office, business of your own. Dawson Co., 2443 Myrtle St., [illegible], Minn.

AGENTS—Best seller. Jem [illegible] [illegible] for tires and tubes, supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube. Sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 304 Amazon Building, Philadelphia, Pennsylvania.

WE pay $48 a week, furnish auto and expenses to introduce our Soap and Washing Powder. Buss-Beach Company, Dept. A45, Chippewa Falls, Wisc.

MAKE $[illegible] selling Supreme Shirts means big business, big repeats, big commissions. Write today for FREE Kit. Supreme Shirt Co., 276-F Fifth Ave., New York.

AGENTS—Wonderful newly invented knife sharpener. Sold on lifetime guarantee. Big profit. Demonstration sells. Sample free. Exclusive territory. Conway Co., M 77, Champaign, Illinois.

BIG profits with Exclusive Territory. $50 to $100 weekly easy. More has often been made in one day's work. A kind of rule running water bath equipment for any home at only $7.50. No plumbing or water works required. Investigate. Send no money. Write today. Kent [illegible] Supply Co., [illegible] Building, Toledo, Ohio.

$[illegible] Money and fast sales. Every owner buys gold initials for his auto. You charge $1.50, make $1.[illegible]. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

AGENTS—Hanging names on Pocket Key Protectors; sample check with your name and address, [illegible] Stamping outfits, Emblems, Checks, Check Fobs, Name Plates. Hart Mfg. Co., Desk 2, 303 Degraw St., Brooklyn, N. Y.

SELF THREADING Needles. Needed in every home. Fine side line, easily carried. Big profits. Sample free. [illegible] Brothers, 147 [illegible] St., New York.

A BUSINESS of your own. Making Sparkling Glass Name and Number Plates, Checkerboards, Signs. Big Book and Samples free. E. Palmer, [illegible], Wooster, Ohio.

[illegible] 1.50 Chocolate Bars. Salesman's samples at cost prices. Write for samples and list. Geneva Central Company, 7 [illegible] St., Geneva, N. Y.

SUCCEED With Your Own Products. Make them yourself. Formulas, Processes, Trade secrets. Modern manufacturing methods. Catalog free. [illegible] Co., Washington, D. C.

SELL by mail! Big Profits! Books, Formulas, Novelties, Bargains. Particulars Free! Elfco, 525 South Dearborn Street, Chicago.

YOUR trade demands salesboards. Make up to $15 on single sale. Largest lowest priced line. No samples to carry. Elaborate 3 color catalog free. Lincoln Sales Co., Dept. O, [illegible] Union, Chicago.

MAKE Money silvering mirrors, refinishing auto headlights, tableware, metal plating, beds, chandeliers. Outfits furnished. International Laboratories, Dept. 64, 309 Fifth Ave., New York.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

EARN $[illegible] daily silvering mirrors, plating and refinishing metal ware, headlights, chandeliers, bedsteads. Outfits furnished. [illegible] Decie Laboratories, 1133 Broadway, New York.

SALESMEN selling to men. We have logical side line for you that will sell along with any other line you may now be handling and probably make more money for you, provided you are now selling to men. Get full facts at once by addressing Sales Manager, 844 West Adams, Dept. 611, Chicago.

MANUFACTURER with a successful local record wants salesmen, full or part time, city or country. Manufacturer desires national distribution of article of proven merit, unconditional guarantee, big money, interesting work. Write Highland Machine Co., Sales Dept., 5462 Pa. Ave., N. W., Washington, D. C.

ARE you old at forty? See our advertisement on page 1[illegible] of this issue. The Electro Thermal Company, 4066 Main Street, Steubenville, Ohio.

HARDWARE Salesmen for patented combination padlocks, no keys, cannot be picked, retails $[illegible]; simple, strong, practical lock. Excellent connection for right man with successful growing company. Write Defender Lock Co., Dept. C, 69 Cliff St., New York.

(Continued on page 1[illegible])

Salesmen and Agents Wanted

BIG MONEY. Fast sales, every owner buys gold [illegible] World Monogram Co., Dept. [illegible]

[illegible] 100% Profit Self-Lighting Gas and Cigar [illegible] Everybody interested, repeat business. Sell [illegible] dealers, salesmen. Particulars FREE. [illegible]

[illegible]

[illegible] for $4.95 Guaranteed Tailored Shirts. Samples and style book free. Your pay daily. Cincinnati Shirt Company, Secy. 1608, Cincinnati, Ohio.

[illegible]

[illegible] Big commissions. Extra bonus. Write quick, C915 [illegible] Corp., Middleboro, Mass.

[illegible]

[illegible] Style Arch Shoe Co., Dept. 120-A, Cincinnati, Ohio.

Salesmen and Agents Wanted

WE have a line of goods for which every man in America is a prospect. [illegible]

[illegible]

[illegible] Write free sample offer today! Monogram, 1721 California, San Francisco.

Stammering

[illegible]

Stamps and Coins

[illegible] All different, 2 cents. Lists free. [illegible]

[illegible] Popular Science Monthly, 250 [illegible]

[illegible]

Technical Schools

[illegible]

Typewriters and Supplies

TYPEWRITERS, all makes [illegible]

Wanted

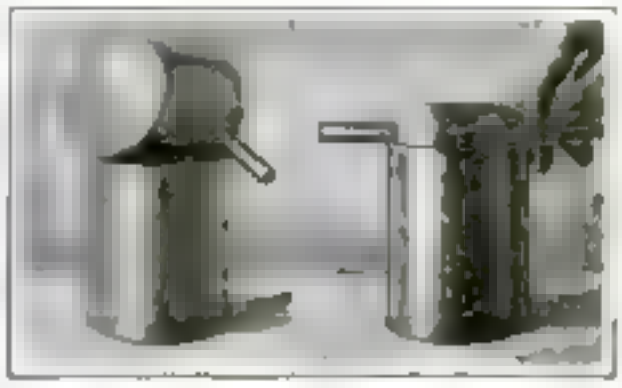
[illegible] needed everywhere. [illegible]

WANTED. Representatives in every city [illegible] United States. Popular Science Monthly, 250 Fourth Ave., New York.

Oil Tank for Hardening Small Parts Uniformly

SPRING pawls and similar small parts are best hardened in oil. It is imperative, however, to keep either the work or the oil in rapid motion.

In our shop we use the double pan arrangement illustrated. As soon as the



The work holding tank with perforated bottom, is whirled in an oil filled container

work is heated sufficiently, it is dropped into the inner bucket, which is revolved rapidly within the outer one. The perforated bottom of the inner pan is set diagonally so that the work is certain to fall toward the outer circumference of the pan and pass through the widest circle of oil.—ARTHUR A. KASPATA.

Can You Grind a Drill?

(Continued from page 5)

turpentine also is sometimes used for glass. In all glass drilling great care must be used in supporting the work so it will not be strained to cause fracture."

"There seems to be quite a lot to drilling after all," said Harvey. "I never thought much about it before, it always seemed so simple and easy that I never bothered my head about it. I wish I knew more about the principles of cutting tools anyway. Can't you give me some more dope on the subject? I'll be glad of any help you can give."

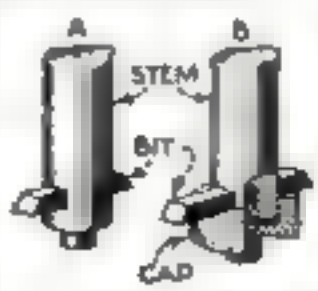
"The study of cutting tools and their action would fill a large book, but if you want to know the reason for anything in particular, I'll help you all I can. Reamers, boring tools, turning and forming tools, milling cutters, all have been developed and their cutting actions studied so that the greatest efficiency can be obtained."

"Thank you, Mr. Grimes," grinned Harvey. "I'll bother the life out of you from now on."

The next article in this series by Mr. Dowd will appear in an early issue.

An Adaptable Counterbore

HALF INCH drill rod makes the stem of the counterbore illustrated. A ⅜-in. tool bit, sharpened on both ends, is held in a square hole by a screw from below. Caps may be made and held on with the same screw to suit larger holes.—I. R. HICKS.



A Doctor Discusses Sex Appeal

(Continued from page 10)

summer sports. Noted artists are frequently employed as judges, and when the time comes to make the final awards they experience great difficulty in reaching a unanimous verdict. When experts disagree, how is the layman to decide? Think back over some of the more widely advertised contests of recent years. How many times have you taken issue with the findings of the judges? Did you not quarrel with them, believing that the girl fourth from the left, who was not even placed, should have carried off first prize?

SO, YOU see, sex appeal is a personal matter. I know a young man who cannot get a single thrill out of the Ziegfeld Follies, but goes into raptures at the sight of any tall girl weighing less than a hundred pounds whose nose is sprinkled with freckles. He, you may have guessed, is tall himself. When a short man marries a tall girl, or when the reverse is true, it is cause for comment. Like seeks like, with a single notable exception—red headed men, generally speaking, do not select girls for their wives whose hair is of the same hue. This has been attributed to the fact that fiery-haired persons generally are hot tempered, and any chance of a permanent alliance is shattered by frequent bickerings in the early stages of the courtship.

Let's go back to the crib again. Baby is crying violently; he wants nourishment, and he wants it on a hurry. His fond mother dashes to the rescue, bottle in hand. Baby discovers early in life that by making a noise he gets attention.

He tries it a second time, a third, a fourth. Its efficacy has not been lessened. He gets the idea that he is of tremendous importance; he learns that it is to his advantage to be imperious.

BABY is now man grown. He seeks a mate. Does he select the self-assured woman of the world, who thinks nothing of going through a dark street at night unattended, who runs her own apartment and car, who makes a larger salary than he? I should say not! He knows that this independently minded young woman will not wait on him hand and foot; he is the one who will do the waiting. So he goes in for the "clinging vine," who will rush his slippers to him when he gets home at night, and echo all his opinions.

Even today the baby doll of the female species draws the crowds, while the self-reliant miss does her act to empty seats. I had an opportunity recently of watching one of those affairs from the vantage point of my window.

Diagonally across the way from my study is a school, and a traffic officer is on duty there most of the day. He is a fine, big, handsome fellow, quite conscious of his superb masculinity; and his protective instinct has been fostered through his daily association with the children of the school.

One block away is a motion picture theatre, whose customers are supplied their tickets by a ravishing blonde—an acquired color, I must confess. And, though the lower crossing would have served her just as well, she chose to brave the traffic at the intersection guarded by the husky cop.

TREMBLING, she would stand on the curb and gaze helplessly at the stream of vehicles. But only for an instant. The cop's whistle would sound; an imperious hand would draw the vehicles up in a panting line, and the young lady would then be conducted to the safety of the sidewalk opposite.

I watched the performance for some time, and occasionally twitted my friend the cop about it. He pretended merely a professional interest, but his blush betrayed him. I was not surprised when he confessed not long ago that the invitations were out.

They're married now. He felt that the poor little blonde needed protection, and he took her permanently under his wing. Now, doubtless, *he* needs protection.

Frequently attention is called to an astonishing resemblance between man and wife, or between the wife and her husband's sister or mother. They serve to bear out my contention of the basis of sex appeal. Not only has the man unconsciously selected for a mate the girl who came nearest to his ideal—his mother or sister—but the wife has, just as unconsciously, molded herself to conform to that model as outlined in the daily expressions of approval or disapproval from her husband.

That being the case, you may ask how it is that a young man, descendant of a long line of blue bloods, elopes with a lady of the ensemble, a person of very vague antecedents. The papers announce that "society is shocked"; the young man's parents keep in seclusion, refuse to be interviewed, and withhold their blessing. Now, you declare triumphantly, how does the mother complex hold here? You search for characteristics common to the proud patrician dame and the little girl from nowhere.

JUST a minute. Who was it that tended the young man in his cradle days? Was it his mother? I'll wager not. And who guided his steps as he toddled about the grounds of the family estate? Undoubtedly a nurse or governess. Find her, and the mystery will be cleared up.

The male members of the community are prone to flatter themselves that their decisions are founded upon judgment. Women, on the other hand, are accused of relying on intuition. In my opinion, judgment may play an important part in a man's life when it comes to making business decisions, but not in the choice of a wife. Your complexes pick her. You are their slave.

When you come face to face with your dream girl, a thousand complexes sense your heart and shout in unison, "I'm going to marry that girl!" And all the judgment in the world will not prevail against them.

That's sex appeal.

"We Can Trick the Wind Into Saving Billions!"

(Continued from page 38)

that either they would not, or could not understand it. Only when he built a small working model of his rotor ship, spinning the rotors by clockwork, did he convince them that it would work. And not until the *Baden-Baden* sailed 6400 miles across the Atlantic, using only twelve tons of fuel oil, as compared with forty-five tons for a motor ship of the same size without rotors, did he convince skeptics of its economy.

THIS economy, he expects, will be demonstrated even more strikingly by the new 3000-ton three-rotor ship *Barbara* recently launched by the German government. Her first long cruise probably will bring her to the United States some time in October.

In the application of the rotor principle to windmills, Flettner sees even a more valuable source of cheap power. The first rotor mill in Berlin is designed to run an electric light and power plant. It consists of a wind wheel, some sixty feet in diameter, with four spokes, and on each spoke is mounted a conical rotor which is spun by a small electric motor deriving its power from a central generator in the windmill tower. The arrangement is such that the wind, always blowing at right angles to the wheel, exerts a side pressure on the revolving rotors. Not only is the force of the wind on the cylinders ten times as great as it would be on sails of the same area, but the rotors respond to the faintest breezes.

TO UTILIZE the wind still further, Flettner now proposes to attach to the outer ends of the spokes four secondary windmills resembling small airplanes with streamlined bodies and propellers set against the wind. Motors driven by these small propellers, the inventor has found, will develop sixty-four times the speed of the main rotor arms.

Whether "blue coal" ever will supplant black coal and "white coal" in industry and commerce remains for the future to decide. In Germany, where nearly seventy-five percent of the available water power now is devoted to useful purposes, engineers are predicting that before long the nation will be obtaining a large part of its electrical energy from the wind. Government Electrical Engineer Foerster, in a recent statement in Berlin, predicted that "the time is not far off when forests of windmills will be centralized in various parts of the country to supply power and light to near-by cities and factories."

For the present, Anton Flettner has succeeded at least, in arousing the world to the wealth that howls about our windows.

ANTON FLETTNER'S first rotor ship was a small working model driven by clockwork. "How would you like to build one like it? An article in next month's Home Workshop Department, prepared under Flettner's personal direction, will suggest easy ways of doing it.

A GODFATHER OF INVENTORS

(Continued from page 21)

get experiments convinced the Stevenses that gunfire of the day would not be effective against ships protected by iron plates, preferably sloped at an angle. In 1812 they concluded that four and one-half inches would be about the proper thickness. Some forty years later, De Puy du Lome, the great French constructor, adopted this as the average of the iron-clad fleet he built for Napoleon III. And the Confederacy's *Merrimac* had four-inch armor.

SEVERAL ideas of public and commercial interest were engaging Colonel Stevens' attention at about this same period. He had been engineer for the Manhattan Water Company when the first pipes to serve New York houses with fresh water were laid. This led him to suggest fire boats, to protect the warehouses on the water front and also, during the yellow-fever epidemics, to propose building floating hospitals off the city, to care for the sick or for the babies of the city. Also he suggested the New York elevated railways that were not to be constructed for more than half a century. As an amusement, he became an ardent horticulturist, attempting to include in his Hoboken garden a specimen of every flower native to America and many that were imported. In this connection he is credited with having introduced into this country the Chinese chrysanthemum. Also, following out his plan of making Hoboken a pleasure resort, he laid out shaded walks and drives along the river, beside which he erected a crude sort of Ferris wheel and the first American "roller-coaster," based upon the Russian idea of tobogganing. In this last he had a practical motive -demonstrating what could be done with railroads, both gravity and otherwise.

For railroads meant most of all to John Stevens. It did not disturb him that there were no such things as railroads at the time; he was perfectly certain they would come. He published all his views in a pamphlet of most extraordinary vision, containing plans, specifications, and estimates of cost. Aptly enough, a railroad official to whom I showed one of that excessively rare editions a few weeks ago called it "the birth certificate of American railroads." Yet it was three years before John Stevens, after writing to every prominent man in public life, succeeded in getting a charter from New Jersey, and it was eight years more before he got one from Pennsylvania, with the help of Stephen Girard.

Even the charters meant little at first, for it was years before men gained courage to break ground. But part of the great Pennsylvania system was finally built under those very charters. Fortunately for Stevens, he lived to be nearly ninety, long enough to see other men's vision begin to catch up with his own, and long enough to know that his son Robert had invented the steel rail which has since become the standard throughout the country. But surely his greatest moment must have come to him, on that afternoon a century ago, when he made his own "steam-carriage" run upon his own rails!

With steamboats and railroads John Stevens laid the foundation for the commercial progress of the United States. With projectiles and iron-clads he—and his sons—proposed the best method of protecting the nation from outside aggression. And still his record of far-sighted vision is not complete.

"NEW YORK" he declared, "will become, at no distant day, one of the world's greatest cities. Our citizens will insist upon visiting it, on business or on pleasure, at all seasons. It will not do to allow it to be cut off, nor will it suffice that we be able to reach it by slow moving ferries. Ourselves and our trade must find readier and faster means, in winter as in summer."

To make good his own words, he drew up careful plans for building bridges over the Hudson and the East river. At first he proposed floating bridges, with draws; later bridges on piers, the spans to be so high in the air that any vessel could easily pass under them. In both cases, however, shorter-sighted men opposed him, insisting upon the delays and obstructions to river navigation which would result from any sort of bridges. Without influential support, Stevens was unable to secure a charter for bridges. Almost immediately he came out with still another idea—perhaps the most brilliant he ever had.

"Let us build cylinders," he said, "each in the form of the frustrum of a cone." He then went on with complete details for joining these cylinders together in a line across the Hudson, *sinking them into the river-bed, pumping them out, and leaving them with brick or heavy stone.*

"In this way," he concluded, "we shall have a tunnel, through which our countrymen may, at all seasons, drive themselves, their families, and their produce into our greatest city."

WHO knows what might not have been accomplished in engineering triumphs of a hundred years ago, if only other men had had his courage and dared to back him in his enterprise?

Father or grandfather of half a dozen American inventions, and godfather of all the rest. First in the field with the twin-screw propeller and the American steam-carriage on rails. Projector of the elevated railway, the iron-clad ship, and the modern armor-piercing projectile. All these make up an impressive list. But to cap it with a proposal for the vehicular tunnel, on a principle actually patented only about fifteen years ago and not quite yet an established fact under the Hudson!

In the whole history of the world, measuring by the standards of mechanical knowledge of his own day, where is the man of brilliant vision; the inventor, or the engineer, who can stand higher than Colonel John Stevens, of Hoboken?

The Boy Whose Big Feet Paddled Him to Fame

(Continued from page 19)

"It took practice, yes, lots of it. But I got better and better all the time."

For the benefit of those who might like to increase their swimming speed, Johnny quite willingly explained the details of his stroke.

"Almost everybody's stroke is different from any other stroke," he explained, "and no one should attempt to change his style, if it feels natural. He simply should try to improve his natural method.

"The first thing to learn is not to reach too far forward with the right arm in beginning the stroke. Keeping the right shoulder above the water is essential, and then the swimmer should reach out in front of him and a little to the left of the center of the head, keeping the right arm slightly crooked at the elbow. The breath is then inhaled, and as the right arm is pulled under the body the head goes completely under water. The right arm straightens as it travels back until it is fully extended at right angles to the body, and the pull is made as deep as the length of the arm will permit. The stroke is toward the left knee. I always like to say that a swimmer should hug the water.

"Exactly the same method is used with the left arm stroke. The breath is exhaled under the water at the finish of the left arm stroke, and inhaled again as the right arm stroke begins and the head is out of the water again.

"Kicking should be timed with the arm stroke. I take three kicks, alternating with right and left foot, as the right arm stroke is taken, and three more with the left arm stroke. The feet should never be permitted to be more than eight inches apart, and they should be held at a sort of pigeon-toed angle. That gives them more paddling force. It would be best to time the kicking like this: Right arm starts down, right foot kick; right arm at deepest extension, left foot kick, right arm at knee, right foot kick. Left arm start, left foot kick, left arm at deepest extension, right foot kick, left arm at knee, left foot kick, and so on in a kind of rhythm. That can be practiced pretty well on dry land.

"Always try to swim with head up. That will help to develop the arch in the back and cut down body resistance to the water. Head and feet up keeps the arch in the back while swimming.

"That really is all there is to fast or long swimming—that and practice."

Johnny is not greedy about owning or holding records. Many of those he has won, he modestly explains, he just had to win because there has not been anybody, up until now, who really could compete with him.

"From now on," he announced, "I am going to limit myself to the sprints—nothing above the 300 meter mark. Arne Borg (a team mate) is the real middle-distance swimmer.

(Continued on page 108)

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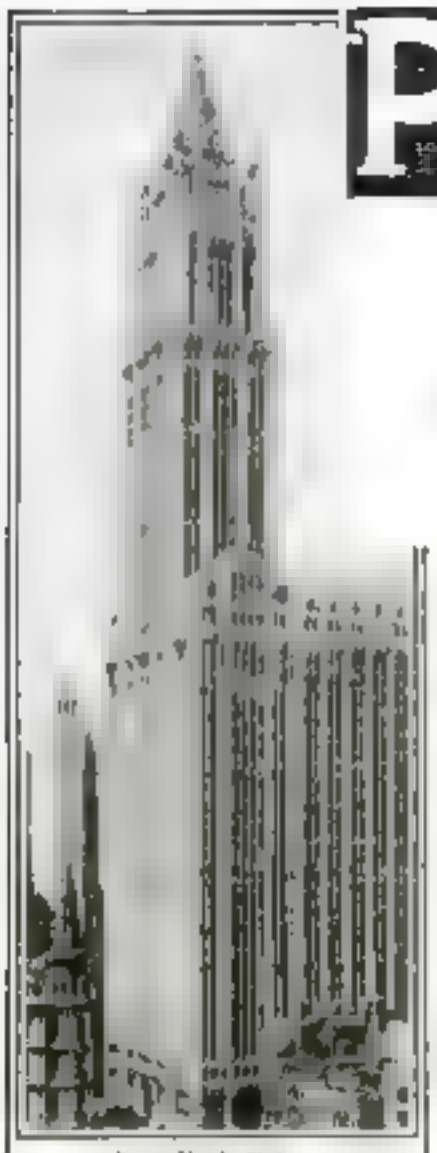

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Boy Whose Big Feet Paddled Him to Fame

(*Continued from page 106*)

He can outlast me, and I think he is going to be the champion in everything above the 440-yard event.

"I am a sprinter. When I swim in a contest I put everything I've got into it from the start. I never let anyone else set the pace in a race. The others have to put all they've got into it from the start, too, in order to keep up with me, or really follow my pace.

"Where I win is in the last twenty of the 100 yards. I don't spurt the last twenty, though most of the men I have competed with say or think I do. It is just that they have begun to slow down, to drop back, yet think that they have kept going just as fast as they had started. They put the same, and maybe more, muscular effort into their swimming than they had been doing at the start, and that, in itself, slows them up."

"BUT how do you always manage to keep up your terrific starting pace?"

"Practice. Bachrach has taught me where to relax—what muscles to relax. I synchronize my footwork with my arm strokes so that when my arms tire, my legs take the burden and when my legs need rest, my arms do the work. I am never strained, muscularly, in the water—never making the muscular effort that a track runner has to make, for instance. I never use a muscle that should not be used in swimming, and that helps me conserve my energy for speed."

At this juncture Bachrach loomed up—he always "looms" because of his bulk and his baggy trousers.

"This boy," he said, "is the world's premier swimmer because he has the native ability to swim. He has the gift of muscular coordination to a greater degree than any other swimmer in the world excepting Ethel Lackie. Johnny has also the ability to think when he is racing. The development of his crawl stroke is, of course, the result of practice, but he had it to begin with. Just so has Ethel Lackie, probably to a greater degree than Johnny.

"THOSE are the reasons why Johnny is the great swimmer that he is. I have had little to do with it. If he had not had the stuff in him, I could not have put it there. You can take a young kitten and make it learn to walk like a dog—but it won't be a dog when it grows up. No sir; it will be a cat. You can teach most anybody how to take swimming strokes, but unless they are born swimmers they will never be swimmers worthy of the name."

Native ability seemed to imply that Johnny had come by his honors through ancestral excellence in swimming, but Johnny disclaimed the heritage.

"No, my father was a coal miner in Windber, Pa. He could swim, but not much. Sort of like that cat Bachrach just mentioned. Neither could my grandfather, nor any other member of my family that I ever heard of."

But thoughts of things other than swimming are beginning to whirl in Johnny's head. His next ambition is golf. He has been playing golf seriously for about two seasons, and again his power of muscular relaxation and synchronization is being used to his advantage, for he is shooting under ninety consistently on all of the hardest courses around Chicago.

"I would like to be an amateur golf champion, too," said Johnny, "but I am afraid I'll never be able to give golf enough practice to become really good. Swimming takes up so much of my time that I cannot seem to get in enough hours on the links, and I think that to become really expert in golf I'd have to practice it and study it just as hard as I have had to do with swimming."

"BUT what are your plans for the future—the commercial future?" asked I, in the obvious knowledge that one cannot eat medals, and amateurs get nothing but.

"That's something I have got to decide pretty quickly," he replied, with a serious expression that sat queerly on his hitherto boyishly carefree face. "I think that I shall try the movies. Douglas Fairbanks and Mary Pickford had me out for a visit last summer, and they gave me a lot of encouragement along that line. They even made a movie of me and 'Stubby' Harold Kruger (a championship team mate), in our little comedy stunt called 'The Pool.'"

"You mean you want to become a regular actor?" I asked him, rather astonished.

"Yes," he answered simply. And there have been many stranger things than that, because Johnny Weissmuller likes to play. All artists, be they actors, poets or painters, play at living and live at play.

So does Johnny Weissmuller, who, at twenty-one years of age, standing six-feet-three with his 190 pounds of bulk, has as his sole philosophy of life:

"Keep at what you want to do if you would do it better than anyone else; keep at the getting of happiness if you would be happiest."

And, after all, the majority of the world's swimming records stand as evidence that Johnny is right in the first part of his motto, at any rate.

Recent Publications

Glass and Glazing, by Emanuel E. Ericson. Simple, explicit directions telling the amateur how to select and work with glass in new construction or repair work in buildings and furniture. The author is well-known to readers of POPULAR SCIENCE MONTHLY as a contributor to the Home Workshop. Illustrated. The Manual Arts Press.

Great Moments in Science, by Marion Lansing. Thrilling moments in which the history of the world has been changed by a scientific discovery. A forecast, too, of great moments that are to come. Doubleday Page & Co.

Here Are Correct Answers to Questions on Page 46

1. Thunder storms are usually caused by great differences in the temperature of different parts of the air. Such differences are commoner in summer than at other times.

2. Of the millions of nerve ends in the retina some are able to see different colors. Sometimes these color nerves are wholly or partly missing or sick or damaged. Then the eye is unable to see any color or can see only some colors.

3. One square foot of the earth's surface directly exposed to the sun receives about 1800 calories of heat per minute. The heat received by the entire surface is equivalent to the burning of about 100,000,000 tons of coal per minute.

4. Because the breeze created by the speeding automobile evaporates the perspiration more quickly and therefore absorbs heat more rapidly from us.

5. Certainly. The birds tend to fall and have to hold themselves up by moving their wings or by gliding. If they folded their wings and rested they would fall.

6. On the roots of plants are millions of root hairs which touch the grains of the soil and absorb the water which wets their surfaces. This water contains chemicals, dissolved from the mineral grains, and these chemicals form the plant's mineral food.

7. So far as we know there are none. Even in the dryest places in the United States, in the Mohave Desert, California, there are occasional storms and few years pass without rain. Even the Sahara Desert is not entirely rainless.

8. The revolution of the earth determines the length of the day. As the earth revolves, the stars appear to move. If you pick out one exactly overhead at midnight you can use that star to set your watch by every night, making allowance for changes in the star's position caused by the earth's yearly motion around the sun.

9. It depends somewhat on the size of the body. The average body contains about two gallons of blood.

10. So far as we know there is no sea serpent. Reports of sea serpents may be due to people seeing several animals together, as, for instance, a string of porpoises.

11. The filaments of electric lamps are made of tungsten, which is able to stand heating for a long time without being spoiled.

12. The yeast for making bread is the same little living plant that makes alcohol. Bread dough contains sugar derived from flour starch which the yeast converts into alcohol. At the same time it produces little bubbles of carbon dioxide gas, which make the bread rise.

Noises You Never Hear

(Continued from page 17)

the absorption of the sound waves by the bodies of the passengers and by their clothes. All soft things absorb sound waves, while hard, smooth surfaces reflect them. In a loaded car the energy of the sound waves goes into heat, so that the clothes and faces of the passengers are made a trifle warmer, though not noticeably so.

Reverberation, which is responsible for many of the disagreeable noises of traffic, is the thing which also makes lecture halls and other large rooms so frequently hard to hear in. The sound of music or of a speaker's voice is reflected back and forth hundreds of times from one wall to the other. Naturally your ear gets confused.

ARCHITECTS try to avoid the shapes and sizes of rooms which they have learned by experience may develop acoustic defects such as this. Even after a room has been built and found to have bad acoustic properties the fault often can be remedied. For example, the late Professor Sabine, of Harvard, devised a kind of plaster which, when applied to the walls, absorbs a part of the sound waves and so lessens reverberation.

Along somewhat similar lines, remarkable experiments recently were carried out in London, England, in efforts to silence the deafening noises produced in an airdrome by airplanes warming up for flight.

In a tank of water in which were placed models of the airdrome buildings, there were set up ripples corresponding in wave-length scale to actual sound waves in the airdromes. By photographing these ripples, A. H. Davis, of the National Physical Laboratory, was able to work out a system of sound screens to kill much of the noise on the flying field.

The effects of noise on health are still largely a closed book. Most of us assume that much noise is harmful. Perhaps it is. But men of some occupations, for example, locomotive engineers, live all their working hours in the midst of great noise and it seems to do them no harm. My own idea is that the harmful effects of noise largely vanish if the noise is continuous. The constant roar of a locomotive in motion is not troublesome. But if you try to sleep close to the railway track and are not used to it, every passing train will wake you.

STRANGE noises are especially annoying. A mouse scratching in the wall may drive a nervous person into actual illness. The famous "death watch" beetle, which sometimes ticks like an irregular clock inside the timbers of old houses in England, annoys people to the verge of nervous prostration.

Moreover, the actual loudness of a noise is by no means the only factor in determining its effect upon us. Much depends on what we have been accustomed to. The crashing sounds of elevated trains, the grinding of street cars, the din of auto horns and all the other markets of a big city, of course, may drive to distraction the man who has lived in the quiet country. Yet it is equally true that the city man who visits the country may be kept awake at night just as much by the modest chirping of insects, the hooting of owls, and the cries of whippoorwills—sounds that are soothing to his country brother.

THERE is one place, however, where the mere loudness of the noise seems to me sometimes to do much harm. This is in offices. So long as the noisy office is occupied, for example, only by typists and their machines, the noise does not matter much. Where it does matter is where talking must be done above the noise. It requires energy to talk and energy to listen if you must strain to hear. I think that this is really a great load on American business. It has the same effect as though we employed only persons who were twenty-five or thirty per-cent deaf.

Fortunately, this is not difficult to cure. The chief noise producer of the American office is the typewriter. In many cases it is possible to put all the typewriters in a single room. If talking is necessary in that room, sound-absorbing felts or other devices can be employed to reduce the noise.

Another problem is that of the automobile horn. What we need is a sound that will warn a pedestrian enough to make him realize his danger, without paralyzing him. When psychologists determine what kind of a noise that should be, undoubtedly we can devise a horn to produce it. For there is scarcely any kind of sound that we cannot produce.

EVEN the sounds that nobody can hear can be created readily. Inaudible sounds have been used for secret signaling, especially under water, between ships.

Professor R. W. Wood, of Johns Hopkins University, recently produced intense beams of these waves, ran them into the water of an aquarium, and killed fish with them. Again, scientists possess a little instrument called "Galton's whistle" which can be adjusted to produce a tone so shrill that no one can hear it.

Many scientists believe that some animals, like the bat, and many insects can hear tones so shrill that they are forever inaudible to human beings. Certainly there are insects which have apparatus apparently adapted for producing such tones. It is quite possible that these creatures can talk to each other continually in sounds to which we are hopelessly deaf.

It is possible, too, that some day we may discover a way to repel or attract insects by inaudible waves. Thus, we might set up silent noise machines to keep mosquitoes or flies away from our houses. On the other hand, if we could find a noise that harmful insects liked, we might play this siren song for them and draw them into traps.

No acoustic engineer is ready to say, as yet, that these things can be done, but neither is any one willing to assert that they are impossible.

Pranks That Memory Plays

(Continued from page 82)

read a notice of the disappearance of a man by his name.

Hurrying to a police station he told the officials he believed he was the missing man. A few moments later he was identified by a member of a firm of which his father is a director. A nation-wide search costing over $100,000 had been made.

THOSE who have made a special study of amnesia have detected at least three types of memory disturbance, any one of which may be responsible. In one type the loss of memory is believed to be due to the destruction of brain cells which act as the storehouses of memory. These break down in such a way that events long past can be recalled, while the memory of recent happenings is lost. Another type is exemplified in the "spotted" memory following alcoholism. While an intoxicated person may talk and answer questions much as if he were normal, when the intoxication has worn off he may recall very little of what has transpired.

In the third type, the memory concepts are stored away safely enough in the brain, but due to a "short circuit" in the lines of mental communication, these concepts cannot find expression in speech or action.

Dr. Menas S. Gregory, noted authority on mental diseases at Bellevue Hospital, New York City, told me recently that many cases of hysterical amnesia can be avoided simply by facing disagreeable facts and surroundings, instead of trying to escape them.

"For instance," he said, "if a man is unhappy in his home, but hasn't the moral courage to face the situation, he is the type likely to have amnesia. He lets the situation prey on his mind, not having the will or power to set things right and at the same time shocking the unpleasantness of telling his wife the truth, until his nervous system becomes so impaired as to bring about a mental break. He is a man accustomed to doing things in the easiest way, following the line of least resistance. Amnesia is a way of escaping reality. If he could face the situation squarely, the mental break would never happen.

A REMARKABLE instance of what may happen to a person who is unhappy and dissatisfied in an atmosphere of unpleasantness and misunderstanding is found in the disappearance several years ago of the cultivated wife of a farmer on the Pacific coast. For some time this woman had been tired and overworked.

One day she went to the barn to call her husband to dinner. She saw him standing at the barn door looking at the high heels she wore. That was the last she remembered.

When she "awoke," she was registering in a little hotel at Portland, Ore. As she tried to write her name she realized with a shock that she did not know what it was!

Here she was, unable to collect any threads of memory, possessing only a small amount of (Continued on page 112)

Queer Pranks That Memory Plays

(Continued from page 111)

money, and with no clothes except those she wore. In this predicament she started out to find a job. In answer to an advertisement she went to an address which proved to be an insane asylum! There she took a job as an attendant. For days she pondered the idea of speaking to one of the physicians about her loss of memory, but feared he might think her insane. At last, spurred by a growing feeling that she had once had a son who might need her (her sixteen-year-old boy was in school in Washington) she told her story to the doctor. For several days he questioned her, trying to help her recall her past life. Then one day, when she expressed her regret that she was unable to pay him for his services, he replied:

"OH, PSHAW! Forget it. I am interested in your case."

"Shaw—Shaw?"— the woman looked at him in astonishment. "I used to know someone with that name!"

This strange coincidence was the first step in the recovery of her memory, which she regained completely as soon as she saw her husband once more. A familiar face, physicians say, is almost certain to bring back memory to an amnesia victim.

An equally remarkable case was that of a Western minister. One day, while on a hunting trip, he disappeared. Three weeks later he applied for enlistment in the Army. A sergeant recognized him and called him by name. He admitted the name sounded familiar.

His wife was summoned. Upon her arrival, as she rushed to embrace him, the minister recognized her only as a nurse who had cared for him when he was convalescing in a hospital in France. He recalled the hospital and the nurse, but had no recollection of his marriage eight years before. Later, after a rest, his full powers of memory were restored. Experts declared his condition was brought about by war shock.

Some of the effects of the more serious cases of epileptic amnesia, which frequently are responsible for crimes, were described by Dr. Alfred Gordon of Philadelphia, an authority on the subject.

"One of my recent patients, a cashier in a bank," he said, "would suddenly leave his desk, walk to the safe, open it unceremoniously in the presence of other employees, fill his pockets with money and papers and walk out.

"Another man, a tailor, would suddenly leave his shop, enter another store, pick up some goods, and make away with them. When arrested he would deny the theft vigorously. He could not believe he had done such a thing. Finally, aware that he was ill, he consulted a doctor."

As for the more common forms of hysterical amnesia, however, scientists who have made a special study of the disease assure us that the best way to escape suddenly losing our identity is to stop beating about the bush—to face boldly and squarely the realities of life about us.

Keeping Your Car in the Pink of Condition

(Continued from page 60)

"After you have wiped off the body with the chamois skin to remove all the water, take an old piece of soft silk and polish the body with it. Somehow, silk is better than cotton as a polisher, especially on enamel and these new lacquer finishes."

"How about the running gear?" Murray questioned. "That always gets covered with a coating of dirt all gummed on with grease. Can you get that off with soap too?"

"If it hasn't been there so long that it is nearly as hard as a rock, you can," Gus answered. "Paint the steering knuckles and parts like that with a little kerosene a few hours before you start washing and you will find that the kerosene will cut the dirt loose so that the soapy water will have a chance to remove it. Gasoline will do of course, but kerosene is better. There isn't much of a shiny finish to the paint on axles and running gear anyway so if you wipe them off with an old rag now and then, the washing job will be much easier."

"BUT how do you get rid of those rust spots around the corners and bolts?" Murray interrupted again.

"Well, washing won't take rust off," Gus answered. "But keep your eyes peeled and whenever you see signs of rust starting be sure to scrape away as much of the rust as you can with your knife blade and then get out the paint brush and touch up the spot. If you don't, the rust will eat its way along under the finish and the spot will grow larger and larger. Of course it makes more progress with some types of auto finish than with others, but no matter what kind of protective coating you have on your car, rust will ruin it in time if you don't watch out.

"Why, I've seen a mud guard that looked all right from the top and yet you could stick your thumb through it almost anywhere. Stones bouncing up from the road had cut through the finish and after several years of rusting, there was nothing left but a thin shell of rust underneath the enamel."

"How would it do to take the car into one of these 'auto laundries' once a month and have it cleaned right?" suggested Murray.

"That's a better idea than letting it go without cleaning provided that the place really understands how to use the high pressure air cleaning system." Gus replied thoughtfully. "If you know a place where they know how to do the job right and get all the dirt off without harming the finish, you're in luck.

"HERE'S something you won't see often," Gus went on as he carefully raised the hood of the well-groomed car. "Just look at that motor. It's clean enough to put in your front parlor as an ornament! That's the way expensive machinery should

(Continued on page 119)

Keeping Your Car in the Pink of Condition

(Continued from page 112)

be kept if you want to get the best possible service out of it, and besides, it's a pleasure to work on a clean motor. You don't have to put on overalls every time you have to change a spark plug or take a look at the breaker points."

"The owner must spend a lot of time to keep it that clean," said Murray admiringly.

"Not so much," said Gus. "About once a month he runs it out back of the garage and gets busy with a pan of kerosene and a paint brush. The kerosene washes away the dirt and wiping with dry rags takes off the film of kerosene and there you are!"

"GOSH!" Murray exclaimed. "I guess the answer is to get a good paint job done on my bus and then take good care of it. Tell me whom you would recommend to do the work and I'll run along and not bother you any more."

"Bet you my flivver against a busted cotter pin that his car will look just as bad a year from today," grinned Joe Clark after Murray had gone.

"Nothing doing!" Gus replied. "I'd sure lose the cotter pin. He's not the kind that cares enough about machinery to take good care of it—but it will keep him amused for a while at any rate!"

Eggs Lack One Vitamine

EGGS are the same as meat, according to an old saying of housewives. But recent experiments with eggs are said to show they are not. Eggs are almost negligible as a source of vitamine "C," the vitamine that prevents scurvy. Guinea pigs fed on eggs of hens taking a diet especially rich in the vitamine, contracted scurvy quickly. Moreover, instead of making them immune from the disease, the diet of eggs seemed to make them particularly prone to it.

Face Powder Danger in Dyes

WHAT a world ours would be without paint and powder! Dr. Miller and Dr. Taussig, American skin specialists, recently told members of the American Medical Association some interesting facts about the composition of face powders.

Face powders, they explained, are of two kinds, the heavy and the light. The heavy powders consist mainly of varying mixtures of precipitated barium sulphate and talcum. The lighter powders are mainly starch. The finest powders contain rice powder, but since this in itself is too "light and fluffy," a little zinc oxide is added to give it "weight."

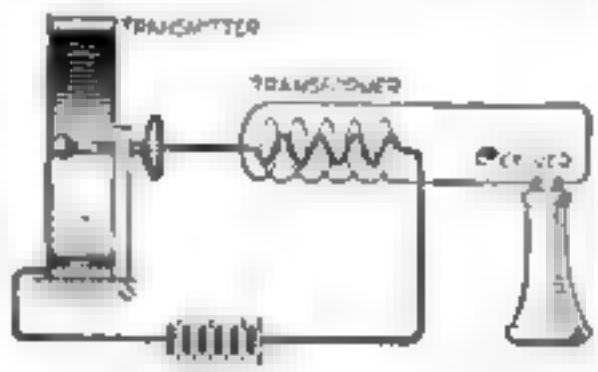
Powders are usually colored with carmine for the flesh tints and yellow ochre or umber for the brunette shades. These coloring matters are harmless, but sometimes, to give brighter and more varying shades, small quantities of aniline dyes are added. And here the trouble may lie, for some of these aniline dyes have been shown to produce skin eruptions.

He Caught the World by the Ear

(*Continued from page 31*)

"Bell had invented a magneto telephone, the energy of the voice producing the current that went over the wire. It occurred to me that the proper way to transmit speech would be by means of battery current. It seemed to me that what I should do would be to make a diaphragm and a contact pin, or screw, touching it in the center, and in some way produce an undulatory electric current by continuous action of that contact."

What Berliner made, as he then described it, was in principle our microphone of today. In fact, the original still in his laboratory is in size and shape so much like our radio microphone in outward appearance, despite its crudity, that it makes an observer smile. He made it out of a toy drum sawed in half, the front portion mounted on a small block of wood with its sheepskin face outward.



The Bell-Berliner telephones, first used in 1879 —Bell's receiver and Berliner's transmitter

On the back of the sheepskin he glued a cork and stuck an ordinary sewing needle through the cork and sheepskin. Through the needle's eye, he threaded a wire.

On the top of the diaphragm he put in a little screw to hold a metal embroidery thread from which a small steel button dangled to make a contact with the point of the needle. This was the first loose-contact transmitter ever invented. It was made in January, 1877, the year after Bell had given exhibitions at the Centennial Exposition in Philadelphia of his magneto telephone.

"I want to say, however," continued Mr Berliner, "that my transmitter was not in good condition; it was still the old membrane, the skin membrane with a patch of iron glued to the center.

"I next rigged up my instrument with an iron diaphragm and made contact with its center with the little round highly polished steel button at the end of the wire from the screw. When I connected it to the battery, all at once I heard a sound coming from that iron diaphragm. I connected my terminals off and on, and heard a loud tick, tick, tick.

"That was strange to me, so I took a tuning fork and held the prongs to the end of one wire and lo and behold, the sound of that tuning fork came from the diaphragm.

"So I made two instruments, each of nothing else but an iron diaphragm and a steel ball, I connected them, one upstairs and one downstairs in the three-story building. I had a friend talk into the instruments upstairs and I listened downstairs, and I could plainly understand what he said.

"I had a lot of trouble with that loose contact, however. If I adjusted one instrument, and then went downstairs to adjust the other instrument, the warmth of the electric current would throw the first one out of adjustment before I could adjust the second. Then I got the idea of an induction coil to step up the current at the origin of the sound. That was the first time an induction coil, or transformer, had been used in telephoning, and I got excellent results.

"FOR a few years the telephone seemingly dropped out of the limelight, but meanwhile the small, struggling Bell Telephone Company had been building longer lines up in Massachusetts for communication between houses.

"One day Thomas A. Watson, who was Mr Bell's assistant, came to see me, and I showed him my home-contact telephones. He told me at once that his company would want what I had. I joined that company later in the year.

"At first the Bell company had used Bell's invention as receiver and transmitter. I had been using my microphone for both purposes, but it was found that best results were obtained by using Bell's invention as the receiver and my microphone as the transmitter, the two forming perfect supplements to each other, as they are in our telephone today."

In next giving the world a talking machine which would reproduce sounds accurately, Berliner perhaps has done as much for our entertainment and cultural development as any other one person.

THOMAS A. EDISON had invented a tinfoil phonograph ten years before Berliner became interested in the idea. Edison's phonograph had been based on a system of sound recording by which sound waves were indented vertically or engraved vertically into a wax cylinder.

"I got the idea, from studying various instruments," said Mr Berliner, "that if I could make a record in which the sound waves traced themselves at every depth and horizontally, like writing, that distortion of sounds reproduced by instruments of the other type would not take place.

"Then, after I had my idea patented, I set to work trying to develop a duplicating process which would enable me to strike any number of records of some wear-resisting material. The disk record readily lent itself to such an idea. At first I tried celluloid, which proved not quite hard enough, so I turned my attention to hard rubber.

"AFTER experimenting for a number of years, I obtained a hard rubber product, but even then the records were not uniformly perfect. I then tried a shellac composition which had been tried by the Bell company in making its hand telephones. These records, at last, showed remarkable uniformity. Moreover, because the material was harder than hard rubber, the reproduced sounds were louder. This instrument proved an immediate success."

Plants That Almost Think

(Continued from page 33)

animals, the strongest instinct that plants possess is the instinct of self-preservation. As with animals, too, their second strongest instinct is the instinct of reproduction.

Unlike animals, plants, being locked to the ground by their roots, cannot go forth in the world in search of mates. With the kind assistance of Mother Nature, however, they have evolved ingenious methods of circumventing the disadvantages of their lack of mobility.

There are two plant sexes, which sometimes are combined on the same stem or in the same flower—for the flowers are the reproductive parts of plants. The male portion of the flowers, known as stamens, shed a yellow powder, called pollen. In the female portion of the flowers, called pistils, are produced the ovules, or young seeds. Pollen must be brought to the ovules for them to become fertile—seeds capable of entering the ground and becoming young plants.

IN PLANTS such as the goldenrod, thistle and dandelion, which have flower tops that are soft, light and feathery, this transfer of the pollen is a simple matter. It is brushed off and carried by the wind to fertilize the ovules of other plants. But other varieties of plants are made so that the pollen cannot be carried about by the breeze. Insects, such as the bee and the butterfly—each, according to the laws of nature, concerned only with its own battle for life, must be persuaded to do this necessary work. Deep down in the flowers of such plants is a store of an exceedingly sweet substance called nectar, which is most attractive to insects. In search of this nectar, the insects visit the flowers, and as they remove it the pollen adheres to their legs and heads. On their next plant visits the pollen is brushed off and fertilizes the tiny ovules.

But competition is keen in the vegetable world, and the plants have found that it pays to advertise. They attract the attention of roving insects by brightly colored flowers, or by sweet-smelling perfumes. Scientists say that the forms of flowers, so beautiful to our eyes, are determined entirely for the convenience of the insects that help fertilize their seeds. The petunia is shaped for the accommodation of moths and butterflies, the form of the nasturtium makes it easy for the humming bird to gather its nectar, the sage is suited to the convenience of the bee. In an orchid that grows in Madagascar the nectar is contained in a spur twenty inches deep—far too deep for any of our insects to obtain it, but in Madagascar there is a moth with an enormous proboscis, which finds the orchid suited exactly to its conformation. As this *Cyrano de Bergerac* of the insect world is not likely to visit any other variety of plant, the orchid is sure that its pollen will not be wasted.

THE wily plants use even man—who usually considers himself the lord of all creation—to help spread their seeds. When you throw away a peach or plum or orange or cherry pit you are falling into a trap which (Continued on page 116)

Plants That Almost Think

(Continued from page 115)

a cunning plant has set for you. The plant wanted those pits—its seeds—to get into the ground, so it surrounded them with a sweet, luscious pulp that you would be sure to eat, but made the pits so hard that you would be as sure to throw them away.

Plants which reproduce their kind by flowering and seeds are the aristocrats of the vegetable world. They range from the tiny duckweed, scarcely larger than the head of a pin, to the mighty sequoia trees of California, the largest of all plants. Plants on lower rungs of the social ladder, such as seaweed, ferns and moss, reproduce by fission, or splitting. When it reaches a certain size the plant divides itself, and there are two plants growing where only one grew before.

THERE is a criminal class in the plant world—plants that are grafters, bandits or even murderers. Like human criminals, they make an easy living by preying on the hard-working members of the community. Few plants die a natural death—they are murdered by the thugs of the vegetable world. A tree will continue to grow, year after year, until a branch breaks because it has become too heavy to support its own weight. Then a deadly fungus will attack the wound for the purpose of feeding on the rich sap—the tree's lifeblood. Soon the whole sturdy tree will be withered and rotten. Then comes death. The blights, rots, molds, mildews, mushrooms, toadstools and other fungi make up this grafting criminal class of the plant world.

Sometimes plants have weapons with which they are able to defend themselves against such enemies as browsing animals, insects and fungi. Thorns, and the poison of such plants as poison ivy and poison oak, are such weapons. Sometimes plants, in an effort to defend themselves against their enemies, enter into alliance with insects. The acacia of Central America, for example, gives lodgings on its leaves to meat-eating ants, which pay their rent by driving away leaf-eating ants which come to attack the plant.

THE redwood trees of California probably are the oldest living things in the world today. Plant life is the oldest life of which we have positive proof. There were found recently, in the Catskill Mountain region of New York State, fossil stumps of trees that grew in the Middle Devonian Age, estimated to be a hundred million years ago.

Yet every year strange new plants are being discovered. Only recently Prof. Samuel J. Record of Yale University, returning from a trip into the forests of Guatemala and British Honduras, reported the discovery of a tree with an abundance of sweet sap resembling milk, and of another tree that gives forth a red liquid like blood.

Scientists admit that they are just beginning to solve the many problems of plant life. Their investigations undoubtedly will bring rich rewards.

Sharpshooting at the Atom

(Continued from page 114)

mass, is 400,000,000 times that of bullet.

So far, Professor Rutherford has been able to knock pieces out of the nuclei of atoms comprising six different elements. These elements, which are all among the lightest, are the gases boron, nitrogen and fluorine; the metals sodium and magnesium, and the non-metallic solid, phosphorus. In each case the piece knocked out has been hydrogen, and the remainder of the wounded atom forms a new element. In a number of instances he has released the spontaneous power of the atom, or at least a part of it.

The chief drawback to his method of attack lies in the fact that his ammunition the alpha ray of helium, is among the rarest of substances. Since however scientists believe that helium may be made from hydrogen, and since hydrogen is the element knocked out of the bombarded nucleus by the helium ray, it is not too much to suppose that an inexhaustible supply of ammunition eventually can be made from the material which that same ammunition sets free.

A SECOND Englishman, Dr. T. F. Wall, tried to effect a change in matter by the use of magnetism. He invented a little wire coil, so small that a man could easily get his arms around it, yet so effective that it can shoot a current of about 250,000 horsepower. Smashing repeatedly at the atom with this vest pocket earthquake, Dr. Wall has produced more electric current than it takes to run the coil itself. He has shaken the atom and made it give up some of its energy.

He predicts that ultimately he, or some co-worker, will develop a beam of cosmic energy to give us power without going through the last mutton of first producing heat, with its accompanying waste.

OF EQUAL interest is the reported success of the German scientist, Prof. Adolph Miethe, of the Charlottenburg Technical College of Berlin, in creating gold from a less valuable metal—a quest of centuries. Professor Miethe first ran intense electric current through mercury vapor contained in an exhausted vessel, with the result that some of the electrons in the current actually pierced the mercury atoms. The product has been tested by the German mint, and pronounced to be the precious metal in every respect. There is some controversy, however, over the experimental methods employed to derive the gold and there is a big drawback to its manufacture on a commercial scale, for the cost of creating the metal is about $2,000,000 a pound, as compared with a market value of $620 a pound.

Using a different method the Japanese experimenter, Professor Nagaoka, obtained microscopic quantities of gold from mercury. While Professor Miethe worked with a small electrical force of about 100 volts at 12.6 amperes, Professor Nagaoka used many million volts. He concentrated this in a narrow space on the surface of the

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Sharpshooting at the Atom

(Continued from page 116)

mercury and kept his mercury lamp running for a long period of time.

In other remarkable experiments the two Dutch scientists, Dr. Arthur Smits and Dr. A. Karssen of the University of Amsterdam, started with lead, a metal very nearly like mercury in its electrical make-up, and using electrical current in a quartz lamp, changed it to mercury.

TO ACCOMPLISH this they melted lead and filled a tube with its vapor. Photographs of the spectrum of this vapor showed that only lead was present. A current of 60 to 100 amperes then was passed through the vapor in the form of sparks following one another at regular intervals. Gradually the lead spectrum began to disappear and was replaced by the lines indicating the presence of mercury. There were lines, too, of thallium, a rare metal lying between lead and mercury in the list of elements. The lead disappeared almost entirely.

America's part in the conquest of the atom has been played by Dr. Gerald L. Wendt and C. E. Irion, who hit a tungsten wire with electric heat so intense that the tungsten changed entirely to helium. This was accomplished by charging a condenser to 100,000 volts and turning the entire amount loose at once on the wire, which was drawn out extremely fine. There was a blinding flash of light—about 200 times as bright as sunlight—accompanied by a deafening report. The light was gone almost instantaneously, in less than the hundred-thousandth part of a second. In that time the wire blew up and the metal of which it was made became helium.

Thus far, all these experiments in transmutation, important as they are, have been little more than amazing scientific "stunts" with little immediate usable value. What scientists want to know most of all is how to get the spontaneous energy out of the atom and put it to use. The incidental problem of transmutation they regard simply as a step toward solving the greater problem of the release of spontaneous energy. A discovery made in one field will always make easier further discoveries in the other.

SOME of the difficulties of attacking the atom have been indicated. In shooting at the nucleus, the percentage of hits is appallingly low. When Rutherford, for instance, bombards aluminum with his alpha rays, he expects that only about two of the helium bullets in every million will ever get near enough a nucleus to break off a piece of hydrogen, although each bullet passes through about a hundred thousand aluminum atoms before it is stopped. In other words, he makes only two good hits in a hundred thousand million shots. And who could expect otherwise when the size of the target is only one ten-trillionth of an inch? It's like shooting at the nose of a man in the moon.

The patience of men who persist in spite of odds so great strengthens the hope that in this generation we may learn to grasp the wasted power that tantalizes.

The Right Material to Build With

(Continued from page 57)

That is, can we take these plans and build from them in whatever material we happen to select?"

"Yes, but not to the best advantage. It is loosely claimed that a house does not need to be specially planned either for tile or concrete block, because there are enough fractional sizes and the mason knows how to fill in odd spaces. The fact is that an exact design for the material you use makes it possible to estimate correctly and order just the units needed. You save time in sorting misfits and avoid a lot of poor makeshifts. Let an architect revise the plan to fit the desired material."

"Hollow tile always has stucco put on it?" inquired the young man.

"NOT always. When it does, the outside is keyed or rough. There are also smooth or matt outer surfaces meant to be left bare—but that's only practical in a region of scant rainfall. Tile with a glazed outer surface will stand the most humid climate, but it's hard to get it. Stucco outside is the general rule. The inside, in dry and warm regions, is calcimined or directly plastered. Again the general rule for most of the country is to have furring strips under wood or metal lath or whatever final interior surface you want. This air space, among other things, takes care of the condensation of moisture on masonry, which is like that we see on window glass and has nothing to do with moisture going through a wall. The point needs emphasis because condensation is an important problem in building and few people understand it at all."

"HOW do you figure this house in concrete block?" asked Rob.

"Call it nine percent more than wood frame, which amounts to $8,102. That's a trifle less than hollow tile. With both stuccoed alike, the appearance is the same. I would choose between the two materials on the basis of availability. Concrete blocks are generally heavier and cost more to transport. But their larger size is a factor that speeds mason work. The standard block, eight by eight by sixteen inches, equals sixteen bricks laid solidly. There is even a block two feet in length, but it takes a Sandow to enjoy juggling with this unit. Blocks are often made scant in the long dimension so as to allow for mortar joints, which we must bear in mind in planning and building. An eight-inch wall is sufficient in blocks. The total thickness, stucco outside and lath-and-plaster inside, is that of a tile wall.

"As with tile, blocks come in all the handy fractional sizes and the various shapes needed for openings, corners, columns and so on. Better have the sills and lintels made on the ground of reinforced solid concrete."

"I suppose the blocks have air spaces and all," said Rob.

"Yes, one or more, and there are sectional kinds in which mortar joints do not go through the wall."

"Can you use the blocks without having stucco put over them?" pursued my young friend.

"You can when a rich cement mixture is on the outside. The surface may resemble granite, limestone or other cut stone. But so many ugly imitations of stone have been made in concrete that all exposed block masonry is now disapproved by the cement people and by architects. Always stucco, they tell us. It's a good rule that has its exceptions. When you stucco, you don't need fancy facings, any block of coarse exterior will serve and it costs less."

"I HAVE seen some stucco houses that were quite beautiful," remarked Ellen. "While I was looking at them I almost forgot my favorite wood colonial. There were several interesting patterns or textures, I believe they call them, of the stucco. And my, what colors! Blues, golds, pinks, I don't know what all. They were almost too gorgeous and stunning."

"We'll switch to stucco yet," commented Rob, winking.

"A lot of people are getting sold on this new-fangled colored stucco," I observed. "America has kind of starved its eyes on drab dwellings. Why shouldn't we liven up with a few art gallery effects on the outsides of our houses? Just as the radio is said to be educating people in music, so this outside adornment of homes may give us a free education in color."

"You notice I have the specifications for our house in wood frame," remarked Rob. "They're supposed to be important, the specifications, what?"

"They certainly are. You don't go to a tailor and order just 'a suit of clothes,' I guess not. You select the cloth, specify linings and go into details of workmanship. It is a pity that many if not most home builders or buyers pick out a house on architectural layout and pass up entirely the specifications, on which quality and workmanship depend. There are several grades of material and likewise degrees of merit in construction, ranging from the slipshod to the extra good. What material and kind of work do your specifications call for?"

"That's what I want to know," said the young man. "There are a slew of figures and trade terms in the document."

"Let's see 'em. At first sight they do read like dog Latin or legal jargon. The only way to understand this stuff is to go over it point by point. I'll do that with you later. On the whole it seems the requirements are pretty standard but some of the elements as given may not quite harmonize from the quality angle."

"THE real question is," said Rob, "what style house Ellen has decided on as the result of this confab."

The young woman laughed and said: "That's easy. We're going to have a synthetic house of wood, brick, hollow tile and concrete block, covered with stucco in a charming rainbow effect."

AS A READER of your magazine, I wish to congratulate you upon the article "Just What Tools Do You Need?" I think a magazine which contains anything on tools contains something really worth while. K. McK., Alba, Texas.


FOOE-V41-ASXT

Answers and Ratings for the Tests on Page 28

The Memory Test

If you can repeat a row of six digits backward your memory for figures is equal to that of the average adult. Eight digits or more shows exceptional ability.

The Test of Logic

The correct answers are: 1. faster, slower, slower, faster. 2. stronger, weaker, stronger, stronger. 3. younger, older, younger, older. 4. sweeter, sweeter, less sweet, less sweet, sweeter.

If three of your four sets of answers are correct you have made an excellent score.

General Information Test

A score of more than twenty-five answers correct is above the average. The answers are:

1. burn; 2. eyes; 3. color; 4. trees; 5. privileges; 6. color; 7. gloom; 8. Philadelphia; 9. green; 10. wick; 11. Pershing; 12. elephants; 13. hay; 14. checkers; 15. worm; 16. Edison; 17. lungs; 18. mines; 19. midnight; 20. iron; 21. drink; 22. baseball player; 23. religion; 24. farming; 25. automobile; 26. Scott; 27. cattle; 28. harness; 29. Paris; 30. cloth; 31. radium; 32. trees; 33. neck; 34. shaft; 35. hexagon.

Next Month—The Best Tests You Ever Tried

IN NEXT month's issue of Popular Science Monthly *will appear the first of a most unusual new series of brain tests, prepared by Sam Loyd, the world-famous puzzle expert. These tests will be entirely different from any you ever have tried, for in them Mr. Loyd has ingeniously combined the scientific yardsticks by which psychology measures human abilities with entertaining puzzles which everyone can enjoy. He has a new treat in store for you that you won't want to miss.*

How Crooked Radio Men Steal Your Money

(Continued from page 50)

all the boss's man had to do was to look real solemn and tell 'em the "works" needed repairing and then load the whole outfit on the truck and bring it down to the shop. Here it stayed around collecting dust until the boss decided that it had been out long enough to look like a lot of work had been done on it, and after that it went back with a nice, fancy bill.

I quit the next day and I am glad to say that now I'm working for a radio concern that plays square. A customer who knows nothing about radio gets the same fair treatment that the experienced radio fan does.

How did I figure it out? Just by making sure that the concern was agent for a good line of radio sets before I asked for a job. You can bet your boots that the really high class radio manufacturers are not going to make agency arrangements with a man who hasn't a reputation for fair dealing, and if you ever have a radio set that needs service you had better judge as to who is to do the work for you by the same rule.

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More Than Two Hundred Articles and Pictures, Including:

"You bet I will"

Chesterfield
CIGARETTES

Use It—And

I'll Guarantee To Keep You in Razor Blades for Life!

Surprising New Invention Upsets All Established Shaving Traditions And Methods. It Carries My Sensational Written Guarantee (In Writing) That You Need Never Buy Blades Again—Never! Astonishing Introductory Offer Good 30 Days Only

How It Works

The operation of KRISS-KROSS stropper is absolutely modern. Blade slips into holder in a jiffy. Patent clip locks it firmly. Strops all kinds of blades on market (except Durham).

Two hands plus 11 seconds and the trick is done. Everything automatic. Just like a watch and KRISS-KROSS gives your blade the keenest cutting edge that steel can take.

THINK of it! 365 keen, cool shaves a year from the same blade. That's what KRISS-KROSS is doing for American shavers everywhere.

This amazing invention marks such a radical advance in shaving comfort and economy that it really deserves to be called much more than a stropper. Rather it is a *super stropper or blade rejuvenator*. Makes hundreds of keen, quick shaves blossom where only one grew before—and prolongs the life of any make blade for months and even years!

KRISS-KROSS strops your blade on the diagonal just like a master barber. Eight "hefty" leather grooves do the trick in 11 seconds. Pressure decreases automatically every stroke. Nickel jig flies up to notify you when your blade is ready with the **keenest cutting edge that steel can take!**

Mystery Razor FREE Too!

And now for my sensational guarantee offer: To make new friends for KRISS-KROSS stropper, I am giving with it **free** a surprising new kind of razor. Really 3 razors in one. Instantly adjustable to any shaving position. Flip of the finger makes it straight, T-shape or diagonal in a jiffy. Exclusive feature cuts beard resistance 43%. Simply zips through the toughest crop of whiskers and gives you the slickest shaves of your life. Nothing like it ever before!

This unique razor, with 3 special-process blades, completes the outfit with which I guarantee to keep you in razor blades for life. Here's how the plan works: Use the razor and blades, renewing them with KRISS-KROSS. If one of them goes back on you for any reason (except rusting or nicking) I'll recondition or replace them with new ones free of charge. No time limit. No strings. No red tape. I give you my amazing guarantee in writing. It is an iron clad agreement to **Keep You in Razor Blades for Life!**

Send for Full Details

Write for free information on this astonishing invention and **free** razor offer! KRISS-KROSS is never sold in stores. You deal direct with me or my authorized representative. Send for illustrated description and details on this limited offer. It's even more remarkable than I can tell you in this small space. No obligation. Just clip and mail the coupon today!

AGENTS ARE MAKING $350 A Month and Up

Make big money with KRISS-KROSS. Giving away **free** razors boosts your profits amazingly. It has made $50 in one day. N. C. Page made $504 in 3 days. Others average $150 and up to $350 a month! 9 out of 10 men buy on sight. SPARE-TIME workers, OFFICE and FACTORY men making $6-$12 extra a day showing KRISS-KROSS to friends and fellow-employees. S. Kantak, steamworker, made $154 extra just working evenings 3 weeks. We give you free $5000 salesmanship Manual and show you easiest way to start cashing in. Countless big commissions. Get details at once. Check coupon at coupon and mail it tonight!

Rhodes Mfg. Co., Inc., Dept. K-240,
1418 Pendleton Ave., St. Louis, Mo.

Without obligation, please send me full details of your special introductory offer to keep me in RAZOR BLADES for LIFE. Also illustrated description of KRISS-KROSS super stropper and FREE 3-way razor.

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Sold only through Authorized Representatives

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